Chapter 20 Temperature Measurement of FB-PLC and PID Control

FB-PLC provides two kinds of modules with different outlook and size for temperature measurement. One kind of the modules is called slim module with 2 points of general purpose analog input & 4 points of temperature input, named by FB-2AJ4 (for J-type thermocouple),FB-2AK4 (for K-type thermocouple),FB-2AH4 (for PT-100) and FB-2AT4 (for PT-1000). They can be expanded up to 8 modules, with 32 temperature inputs in total at the most. The other kind has a built-in 4 points analog input module with large number of temperature measuring points, named by FB-4AJxx or FB4Akxx (the xx could provide 12, 18, and 24 totally 3 kinds of measuring points). This module with large number of points can only be used alone and can not be installed together with other temperature measuring module or with other analog input modules.

Both of the above-mentioned temperatures measuring modules have their properly convenient instructions that are used for multiplexing temperature measurement. FB-2AJ(K)4/FB-2AH(T)4 employs FUN72(TP4) while FB-4AJ(K)×× employs FUN85(TPSNS) to get the engineering value of temperature measurement . As to the temperature control, it also has its properly convenient PID instructions. FB-2AJ(K)4/FB-2AH(T)4 employs FUN73(TSTC) while FB-4AJ(K)×× employs FUN86(TPCTL) to perform the PID operation to control the heating or cooling of the temperature process.

20.1 Specifications of temperature measuring modules of FB-PLC

20.1.1 FB-2AJ(K)4 : with 4 points of J(K) thermocouple input and 2 points of analog input

| Specifications | | | cations | Module | | | | | |
|----------------|--------------|-------------|---------|---|---|-------------------------------------|-----------------------------------|--|--|
| Items | | | | FB-2AJ4 FB-2AK4 | | B-2AK4 | | | |
| | Input points | | | 2 (1 st & 2 nd 1 (3 rd analog | analog inputs as the ger g input for temperature n | neral purpose input neasurement) |) + | | |
| t | | Resolution | ı | | | 12 bits | | | |
| g Inp | | | *10V | 1.Voltage | $-10V \sim 10V$ | 5.Current | -20mA~20mA | | |
| Analo | Snon | *Bipolar | 5V | 2.Voltage | $-5V \sim 5V$ | 6.Current | $-10 \text{mA} \sim 10 \text{mA}$ | | |
| | Span | Uninolor | 10V | 3.Voltage | $0V \sim 10V$ | 7.Current | 0mA~20mA | | |
| | | Unipolar | 5V | 4.Voltage | $0V~\sim~5V$ | 8.Current | 0mA~10mA | | |
| | Input points | | | 4 (Multiplexing via 3 rd analog input) | | | | | |
| | Exp | ansion allo | owed | 32 points (8 modules) | | | | | |
| | Sensor | | | J-type thermocouple | | K-type | K-type thermocouple | | |
| Input | | *Bipolar | *10V | –200°C~750°C | | -: | –200°C~900°C | | |
| ture | Valid | | 5V | -200°C~420°C | | –200°C~450°C | | | |
| pera | range | Unipolar | 10V | | 0°C~750°C | | 0°C~900°C | | |
| Tem | | | 5V | | 0°C~420°C | | 0°C~450°C | | |
| | | Resolution | ı | 1°C | | | | | |
| | C | compensati | on | Built-in cold junction compensation | | | | | |
| | | Update rat | е | 2 Sec. (Adjustable) | | | | | |
| | Accuracy | | | Within ±1% of full scale | | | | | |
| Insulation | | | | | Photoco | ouple isolation | | | |
| | Pov | ver supply | | | 24VD0 | C±10% | | | |

* : It means default setting.

| Specifications | | | Module | | | | | | |
|----------------|-------------------------|-------------|-------------|--|----------------------------|-----------------|----------------|--------------------------------------|-----------------------------------|
| Items | | | FB-4AJ(K)12 | | FB-4AJ(K)18 | | -4AJ(K)18 | FB-4AJ(K)24 | |
| ıt | | Input point | ts | 4 (1 st ∼4 th an 4 (5 th ∼8 th an | alog inputs alog inputs | as th for te | e gen mpera | eral purpose inpu ature measureme | t) + nt) |
| dul | | *Dinalar | *10V | 1.Voltage | -10V | \sim | 10V | 5.Current | -20mA~20mA |
| alog | 0 | ырогаг | 5V | 2.Voltage | – 5V | \sim | 5V | 6.Current | $-10 \text{mA} \sim 10 \text{mA}$ |
| Ana | Span | Lininglar | 10V | 3.Voltage | 0V | \sim | 10V | 7.Current | 0mA~20mA |
| | | Unipolar | 5V | 4.Voltage | 0V | \sim | 5V | 8.Current | $0mA{\sim}10mA$ |
| | Input points (Fixed) | | | 12 | | | | 18 | 24 |
| | | Sensor | | J-type thermocouple (K-type thermocouple) | | | | | |
| ndu | | *Bipolar | *10V | -200°C∼750°C (-200°C∼900°C) | | | ~900°C) | | |
| l ar | Valid | | 5V | | -200°C~4 | 120°C |) (| –200°C | ~450°C) |
| eratı | range | Unipolar | 10V | | 0°C~7 | 750°C |) (| 0°C | ~900°C) |
| due | | | 5V | | 0°C~4 | 120°C | ; (| 0°C | ~450°C) |
| Te | | Resolutio | n | 1°C | | | | | |
| | C | Compensat | ion | Built-in cold junction compensation | | | | | |
| | | Update rat | te | 2 Sec. (Adjustable) | | | | | |
| | Accuracy | | | Within ±1% of full scale | | | | | |
| Insulation | | | | Photocouple isolation | | | | | |
| | Po | wer supply | | | | | 24VD0 | C±10% 、5VA | |

20.1.2 FB-4AJ(K)12/18/24: with 12/18/24 points of J(K) thermocouple input and 4 points of analog input

* : It means default setting.

20.1.3 FB-2AH(T)4: with 4 points of 3-wires PT-100 (PT-1000) RTD input and 2 points of analog input

| Specifications | | Module | | | | | | | |
|----------------|--------------|------------|--------------------------|--|--|--------|----------|----------------------|-----------------------------------|
| Items | | | FB-2AH4 (PT-100) FB-2/ | | AT4 (PT-1000) | | | | |
| og Input | Input points | | | 2 (1 st & 2 nd ana 1 (3 rd analog ir | 2 (1 st & 2 nd analog inputs as the general purpose input) + 1 (3 rd analog input for temperature measurement) | | | |) + |
| | Res | solutio | n | | | | 12 | bits | |
| nal | Spar | ı | *10V | *1.Voltage | -10V | \sim | 10V | 3.Current | -20 mA \sim 20mA |
| 4 | (Bipola | nr) | 5V | 2.Voltage | – 5V | \sim | 5V | 4.Current | $-10 \text{mA} \sim 10 \text{mA}$ |
| | Input points | | | | 4 (Multiplexing via 3 rd analog input) | | | | |
| Ħ | Expans | ion all | owed | 32 points (8 modules) | | | | | |
| Inpu | | polar) DIN | *10V | | | I | 49.8°C ~ | ~ 146.6°C | |
| ture | (Bipolar) | | 5V | | | _ | 12.3°C ~ | ~ 83.6°C | |
| bera | range | e JIS | *10V | | | _ | 50.7°C ~ | ~ 149.2°C | |
| emp | 9 | | 5V | | | _ | 12.5°C ~ | ~ 85.1°C | |
| F | Resolution | | | 0.1°C | | | | | |
| | Upd | ate ra | te | 2 Sec. (Adjustable) | | | | | |
| Accuracy | | | Within ±1% of full scale | | | | | | |
| Insulation | | | Photocouple isolation | | | | | | |
| | Power su | upply | | | | | 24VDC±′ | 10% [、] 5VA | |

* : It means default setting.

Note: The temperature modules mentioned above all with built-in general purpose analog inputs and dedicated analog input for temperature measurement, the memory mapping of these modules as followings: Addressing of FB-2AJ(K)4 and FB-2AH(T)4 : The 1st and 2nd analog inputs are the general purpose input by accessing R3840 and R3841;and the 3rd analog input is dedicated for 4 points of temperature measurement (by multiplexing method) by accessing R3842 (if this module is the 1st analog input expansion module). Addressing of FB-4AJ(K)xx : This kind of modules could only be installed alone, therefore, the 1st ~4th analog inputs are the general purpose input by accessing R3840~R3843,and 5th~8th analog inputs are dedicated for upto 24 points of temperature measurement (by

multiplexing method, one analog input for 6 points of temperature measurement).

20.2 The procedure of using temperature measuring module of FB-PLC Explanation



20.3 Explanation on the hardware of temperature measuring module



20.3.1 The outlook of FB-2AJ(K)4 and top view of PC-board

A : Outlook of top view

B: PC-board top view (uncovered)

(4)

①: External power input terminal -

Power supply for analogue circuit of FB-2AJ(K)4 module, supply voltage is 24VDC±20% °

- ②: Protection ground terminal
 - To connect to the safety earth ground of the power system.
- ③: Expansion input cable –
- It must be connected to the front of expansion unit or main unit.
- ④: Expansion output connector
 - Provide the connection for next expansion unit.
- ⑤ : Power indicator −

Indicating the status of external power input and power supply of FB-2AJ(K)4 analogue circuit.

- 6 : Framing ground terminal
 - To connect to the shielding of the analog input wiring.
- O : Analog input terminal for Al0
 - To connect to the 1st general purpose analog input.
- \circledast : Analog input terminal for Al1
 - To connect to the 2nd general purpose analog input.
- $\textcircled{0} \sim \textcircled{0} : \mbox{Temperature input terminals for CH0} \sim \mbox{CH3} \mbox{To connect to the corresponding thermocouple.}$
- (3 · (4) Selection jumpers of voltage(V)/current(I) input for Al0 (JP3) and Al1 (JP4)

(5) : Selection jumper of input span 10V/5V

The selection to define the input span of all analog inputs of this module. If setting the jumper at 10V position, it represents the measurement range of 10V/20mA/1000°C; if setting the jumper at 5V position, it represents the measurement range of 5V/10mA/500°C.

| Jumper Setting | | | | JP2 10V 5V | |
|----------------------|-----------------|-----------|----|----------------|--------------|
| | Unipolar | Voltage (| /) | 0V~10V | 0V~5V |
| Span of | (U) | Current (|) | 0mA~20mA | 0mA~10mA |
| analog Input | Bipolar (B) | Voltage (| /) | -10V~10V | -5V∼5V |
| | | Current (|) | -20mA~20mA | -10mA~10mA |
| Span of | Unipolar (U) | | | 0°C~1000°C | 0°C∼500°C |
| Temperature input | Bipolar (B) | | | −1000°C~1000°C | –500°C∼500°C |

(6): Unipolar (U) / Bipolar (B) selection

The selection to define the input polarity of all analog inputs of this module. These two jumpers must be inserted horizontally in pairs according to the U, B text direction (which is horizontally printed in its direction) to position B or U as following illustration.

| | \supset | \times | | |
|--------------|-------------|--|------------------------|-------------------|
| Unipolar (U) | Bipolar (B) | JP1 | | JP1 |
| JP1 | JP1 | Jumper vertically in pairs are all incorre | or nserted o ect | r not inserted in |

20.3.2 The outlook of FB-4AJ(K)xx and top view of PC Board





- ① : External power input terminal Power supply for analogue circuit of FB-4AJ(K)xx module, supply voltage is 24VDC±20% ∘
- Protection ground terminal To connect to the safety earth ground of the power system.
- ③ : Expansion input cable It must be connected to the front of the expansion unit or main unit.
- ④ : Expansion output connector –
 Provide the connection of next expansion unit.
- ⑤ : Power indicator Indicating the status of the external power input and the power supply for analogue circuit of this module.
- Framing ground terminal –
 To connect to the shielding of analog input wiring.
- \bigcirc : 1st analog input terminal (CH0) –
- (8) : 2nd analog input terminal (CH1) –
 (9) : 3rd analog input terminal (CH2) –

This kind of module can be used alone and can't be installed together with other analog input module; therefore it has these 4 points of analog input at the most.

- 10 : 4th analog input terminal (CH3) –
- \bigcirc : 1st group of thermocouple input terminals (TC0 ~ TC5) To connect to corresponding thermocouple
- 2^{nd} : 2^{nd} group of thermocouple input terminals (TC6~TC11) To connect to corresponding thermocouple
- (4): 3rd group of thermocouple input terminals (TC12~TC17) To connect to corresponding thermocouple (only for FB-4AJ(K)18 or FB-4AJ(K)24)
- $_{(5)}$: 4th group of thermocouple input terminals (TC18 \sim TC23) To connect to corresponding thermocouple (only for FB-4AJ(K)24)
- $_{10}$ \sim $_{19}$: Selection jumpers for voltage(V)/current (I) input of analog inputs CH0 \sim CH3

The four analog inputs of FB-4AJ(K)×× can be selected individually to be voltage or current input (JP2 for CH0 $^{+}$ JP3 for CH1 $^{+}$ JP4 for CH2 $^{+}$ JP5 for CH3). The selection and insertion of jumper must be identical in direction to the printed text V and I next to it and should be vertically inserted into the position of V or I in pairs.

| | \supset | × |
|-------------|-------------|--|
| Voltage (V) | Current (I) | |
| JP2~JP5 | | JP2~JP5 JP2 |

@ : Selection jumper of input span 10V/5V

The selection to define the input span of all analog inputs of this module. If setting the jumper at 10V position, it represents the measurement range of $10V/20mA/1000^{\circ}C$; if setting the jumper at 5V position, it represents the measurement range of $5V/10mA/500^{\circ}C$.

| J | umper set | tting | | 10V 5V JP6 🔳 🗖 | 10V 5V JP6 I |
|--------------|-----------------|----------------|-----|-------------------|------------------------|
| | Unipolar | Voltage | (V) | 0V~10V | 0V~5V |
| Angles input | (U) | Current | (1) | 0mA~20mA | 0mA~10mA |
| Analog input | Bipolar (B) | Voltage | (V) | -10V~10V | $-5V\sim5V$ |
| | | Current | (1) | -20mA~20mA | -10mA~10mA |
| Temperature | Unipolar (U) | | | | 0°C~500°C |
| span | | Bipolar (B) | | | –500°C∼500°C |

② : Unipolar (U) ∕ Bipolar (B) selection

The selection to define the input polarity of all analog inputs of this module. These two jumpers must be horizontally placed in pairs to position B or U, according to the marked text direction of B and U beside the jumper.

| |) | × |
|--------------|-------------|---|
| Unipolar (U) | Bipolar (B) | |
| | | Either jumpers vertically placed or not inserted in pairs are both incorrect. |

20.3.3 The outlook of FB-2AH(T)4 and top view of PC-board





A : Outlook of top view



- ① : External power input terminal Power supply for analogue circuit of FB-2AH(T)4 module, supply voltage is 24VDC±20% 。
- Protection ground terminal To connect to the safety earth ground of the power system.
- ③ : Expansion input cable It must be connected to the front of expansion unit or main unit.
- Expansion output connector –
 Provide the connection for next expansion unit.
- Fower indicator –
 Indicating the status of external power input and power supply of FB-2AH(T)4 analogue circuit.
- 6 : Common terminal for 3-wires RTD input –
 To connect to the common wire (in general ,the color is red) of each 3-wires RTD input.
- Analog input terminal for AI0 –
 To connect to the 1st general purpose analog input.
- (8) : Analog input terminal for Al1
 - To connect to the 2nd general purpose analog input.
- Input terminal for 1st RTD input –
 To connect to the signal wires (in general, the color is white) of 1st 3-wires RTD input.
- 1 : Input terminal for 2nd RTD input –

To connect to the signal wires (in general, the color is white) of 2nd 3-wires RTD input

① : Input terminal for 3rd RTD input –

To connect to the signal wires (in general, the color is white) of 3rd 3-wires RTD input.

1 Input terminal for 4th RTD input –

To connect to the signal wires (in general, the color is white) of 4th 3-wires RTD input.

(3 · (4) Selection jumpers of voltage(V)/current(I) input for Al0 (JP3) and Al1 (JP4)

The jumper must be inserted vertically in pairs according to the V, I text direction (which is vertically printed in its direction) to position V or I as following illustration.



(5) : Selection jumper of input span 10V/5V

The selection to define the input span of all analog inputs of this module. The polarity of this module supports bipolar only. If setting the jumper at 10V position, it means the range of measurement is $\pm 10V/\pm 20$ mA and the temperature range is $-49.8^{\circ}C \sim 146.6^{\circ}C(DIN)$ or $-50.7^{\circ}C \sim 149.2^{\circ}C(JIS)$; if setting the jumper at 5V position, it means the range of measurement is $\pm 5V/\pm 10$ mA and the temperature range is $-12.3^{\circ}C \sim 83.6^{\circ}C$ (DIN) or $-12.5^{\circ}C \sim 85.1^{\circ}C$ (JIS)

Note : FB-2AH(T)4 is fixed at bipolar, without unipolar/bipolar setting!

| Range | Jumper setting | JP2 10V 5V | JP2 = 10V 5V |
|---------|----------------|-----------------|-----------------|
| Span of | Voltage (V) | -10V~10V | -5V~5V |
| Input | Current (I) | -20mA~20mA | -10mA~10mA |
| Span of | DIN | -49.8°C∼146.6°C | −12.3°C~83.6°C |
| Input | JIS | –50.7°C∼149.2°C | −12.5°C~85.1°C |

20.4 Wiring of the temperature modules

20.4.1 Wiring of the J/K thermocouple input module



20.4.2 Wiring of 3-wires PT-100/PT-1000 RTD input module



20.5 The input characteristic and jumper setting of temperature module

20.5.1 Temperature module of thermocouple inputs

The characteristics of general purpose analog inputs of FB-2AJ(K)4/FB-4AJ(K)xx are identical to the FB-6AD's. Therefore it will not be explained here, please refer to Chapter 18 for details. This section will only tackle on the subject of temperature measuring. The functions and characters of temperature measurement circuit of FB-4AJ(K)×× are all the same as FB-2AJ(K)4's. The conversion character of which is graphically illustrated as follows. Pleas note that effective measuring range of J-type thermocouple falls in $-200^{\circ}C \sim 750^{\circ}C$, but is $-200^{\circ}C \sim 900^{\circ}C$ for K-type. Therefore the marking scale below 200°C and over 750°C or 900°C on the conversion curve does not make sense. Also, it is not possible for temperature to fall below the absolute zero. No matter it's for unipolar/bipolar or 1000°C/500°C span, the content of IR (R3840~R3903) at most it can reach 1842. For the scale exceeding 1842, it is treated for line broken check only.



Figure 2: Bipolar 500°C input span





Figure 4: Unipolar 500°C input span





20.5.2 Temperature module of 3-wires RTD inputs

The characteristics of general purpose analog inputs of FB-2AH(T)4 are identical to the FB-6AD's. Therefore it will not be explained here, please refer to Chapter 18 for details. This section will only tackle on the subject of temperature measuring. By setting the jumper (JP2) to select the measurement range; if setting the jumper at 10V position, the temperature range is $-49.8^{\circ}C \sim 146.6^{\circ}C$ (DIN) or $-50.7^{\circ}C \sim 149.2^{\circ}C$ (JIS) and if the jumper at 5V position, the range is $-12.3^{\circ}C \sim 83.6^{\circ}C$ (DIN) or $-12.5^{\circ}C \sim 85.1^{\circ}C$ (JIS). Please refer to section 20.3.3 for details. The conversion character of this module is illustrated as follows.

Jumper setting 10V



20.6 Notifications for the operation of temperature modules

A Matching with the version of main unit

The temperature measuring module FB-4AJ(K) $\times \times$ must run under the main unit with OS version V.3.30 or later that it can work correctly.

The temperature measuring modules FB-2AJ(K)4 and FB-2AH(T)4 must run under the main unit with OS version V.3.43 or later that it can work correctly.

Note: To tell the version of the main unit, you can just open up the cover on center of the module and check the sticker bearing print out like FB-MAC or FB-MU

or V3.××

The "V3.xx" indicates the OS version of the main unit.

- B > FB-2AJ(K)4/FB-2AH(T)4 can not be used together with FB-4AJ(K)×× module or FB-8AD analog input module.
- $FB-4AJ(K) \times can be installed alone only; it can not exist together with other analog input module or temperature measuring module.$

V3.××

D The unipolar processing of FB-2AJ(K)4 and FB-4AJ(K)xx

The minimum value (0V or 0mA) for unipolar analog input is expressed as -2048 and maximum value is 2047. For easier processing of the calculation, it is necessary to add up the content of IR (R3840~R3903) with a deviation value of 2048, hence to adjust the unipolar analog input value to be $0 \sim 4095$.

E > FB-2AH(T)4 only supports bipolar analog input; it means the resolution will be half if the input is unipolar signal

20.7 Instructions explanation and program example for temperature measurement and PID temperature control of FB-PLC

The followings are the instructions explanation and program example for temperature measurement and PID temperature control of FB-PLC.



- FB-2AH4 provides 2 points of general purpose analog inputs (1st and 2nd analog input) and 4 points of 3-lines PT-100 RTD inputs for temperature measurement (With the combination of 3rd analog input and 8 points of discrete output making 4 points of temperature measurement).
- FB-2AT4 provides 2 points of general purpose analog inputs (1st and 2nd analog input) and 4 points of 3-lines PT-1000 RTD inputs for temperature measurement (With the combination of 3rd analog input and 8 points of discrete output making 4 points of temperature measurement).

| FUN 72 TP4 | Convenient instruction proper to FB-2AJ(K)4/FB-2AH(T)4 temperature module | FUN 72 TP4 |
|--|---|---|
| The select position of unipolar (When set the When set t | tion of input span of FB-2AJ(K)4 temperature module can be 5V (500°C) (when jumper set of 5V) or 10V (1000°C)(when jumper setting at the position of 10V); the input polarity c U/B jumper setting at U) or bipolar (U/B jumper setting at B): ting at10V(1000°C) and unipolar, e range of measurement is 0°C \sim 750°C (J-type) or 0°C \sim 900°C (K-type) ting at 5V(500°C) and unipolar, e range of measurement is 0°C \sim 420°C (J-type) or 0°C \sim 450°C (K-type) ting at 10V(1000°C) and bipolar, e range of measurement is $-200°C\sim750°C$ (J-type) or $-200°C\sim900°C$ (K-type) ting at 5V(500°C) and bipolar, e range of measurement is $-200°C\sim750°C$ (J-type) or $-200°C\sim900°C$ (K-type) ting at 5V(500°C) and bipolar, | setting at the an be set as |
| The select position of When select the select the select position of the select position. | ction of input span of FB-2AH(T)4 temperature module can be 5V (when jumper soft f5V) or 10V (when jumper setting at the position of 10V); the input polarity is fixed for be tring at 10V, range of measurement is -49.8°C \sim 146.6°C (DIN) or -50.7°C \sim 149.2°C (JIS) | etting at the ipolar : |
| When set the | ting at 5V, e range of measurement is -12.3°C \sim 83.6°C (DIN) or -12.5°C \sim 85.1°C (JIS) | |
| FB-2AJ(P points of events of events of events when events when events when events address | ()4/FB-2AH(T)4 multiplexing temperature module occupies 3 points of analog input ad discrete output address in physical; xpension module with analog input will be installed after this kind of module, the analog nust be added 3; xpension module with discrete output will be installed after this kind of module, the discrete s of which must be added 8. | ldress and 8 address of rete output |
| Modules For the s It is record Connect The `G | FB-2AJ(K)4/FB-2AH(T)4 can't be used together with module FB-8AD or FB-4AJ(K)××. election of thermocouple, K-type thermocouple is recommended. mmended to select $0 \sim 5V$ for the span and polarity of input if it meets the requirement. the "FG" terminal with the shielding of thermocouple if it is with for better measurement. $^{\#}$ terminal must be connected to the safty earth ground of the power system. | |
| | | |

FUN 72 TP4

Convenient instruction proper to FB-2AJ(K)4/FB-2AH(T)4 temperature module

FUN 72 TP4

User guide for convenient instruction FUN72

FB-2AJ(K)4 temperature module:

When execution control "EN"=1, this instruction will perform multiplexing temperature measurement and store the primitive value into R3968(TP0)~R3971(TP3) or R3972(TP4)~3975(TP7),...or R3996(TP28)~R3999(TP31); the value falls in 0~4095(unipolar) or -2048~2047 (bipolar). And then base on the setting of temperature sensor (Tp), input span and polarity (PI) of the temperature module to scale the primitive values to engineering values and store them to temperature measurement registers (TR+0 as the 1st point, ..., TR+3 as the 4th point).

FB-2AH(T)4 temperature module:

- When execution control "EN"=1, this instruction will perform multiplexing temperature measurement and base on the setting of temperature sensor (Tp), input span and polarity (PI) of the temperature module to scale the primitive values to engineering values and store them to temperature measurement registers (TR+0 as the 1st point, ..., TR+3 as the 4th point). Then scale the engineering values by the range of 0~ 4095 and store them into R3968(TP0)~R3971(TP3) or R3972(TP4)~3975(TP7),...or R3996(TP28)~ R3999(TP31); the value falls in 0~4095.
- When the setting of Tp, Pl, Sm comes error, this instruction will not be performed and the output indication "ERR" will be ON.
- When the sensor is K-type thermocouple (it needs FB-2AK4 module):
 - 1.As the setting of input span and polarity is $0 \sim 10V$, the range of measurement will be $0 \sim 900^{\circ}C$. When the display value is greater than $900^{\circ}C$, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
 - 2.As the setting of input span and polarity is $0 \sim 5V$, the range of measurement will be $0 \sim 450^{\circ}C$. When the display value is greater than $450^{\circ}C$, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
 - 3.As the setting of input span and polarity is $-10 \sim 10$ V, the range of measurement will be $-200 \sim 900$ °C. When the display value is greater than 900°C, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
 - 4.As the setting of input span and polarity is $-5 \sim 5V$, the range of measurement will be $-200 \sim 450^{\circ}C$. When the display value is greater than $450^{\circ}C$, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
- When the sensor is J-type thermocouple (it needs FB-2AJ4 module):
 - 1.As the setting of input span and polarity is $0 \sim 10V$, the range of measurement will be $0 \sim 750^{\circ}C$. When the display value is greater than $900^{\circ}C$, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
 - 2.As the setting of input span and polarity is $0 \sim 5V$, the range of measurement will be $0 \sim 420^{\circ}C$. When the display value is greater than $450^{\circ}C$, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
 - 3.As the setting of input span and polarity is $-10 \sim 10V$, the range of measurement will be $-200 \sim 750$ °C. When the display value is greater than 900 °C, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
 - 4.As the setting of input span and polarity is -5∼5V, the range of measurement will be -200~420°C. When the displayed temperature value is greater than 450°C, it means the line broken of the thermocouple and the output indication "ALM" will be ON.
- When the sensor is RTD type of PT-100 (it needs FB-2AH4) or PT-1000 (it needs FB-2AT4):
 - 1. As the setting of input span is -10 \sim 10V, the range of measurement will be
 - -49.8°C \sim 146.6°C (DIN) or -50.7°C \sim 149.2°C (JIS)
 - 2. As the setting of input span is -10 \sim 10V, the range of measurement will be -12.3°C \sim 83.6°C (DIN) or -12.5°C \sim 85.1°C (JIS)
 - 3. When the display value is greater than 900.0°C, it means the line broken of the sensor and the output indication "ALM" will be ON.
- Note: When there exists the line broken of the sensor, it can be told from the content of WR+0 working register, which tells the input point(s) of line broken.

| FUN 72 TP4 | Convenient instruction proper to FB-2AJ(K)4/FB-2AH(T)4 temperature module | FUN 72 TP4 |
|--|---|--|
| Sm : S Ym : S it | Starting point of temperature measurement of this module. It must be the multiple of 4, Starting address of discrete output of this module for multiplexing temperature input; takes 8 points of discrete output. | 0≤Sm≤28. |
| AR : A TR : S T | ddress of analog input (3 rd) for temperature measurement of this module. tarting register of the engineering value of temperature measurement, 4 registers in tota R+0 stores the 1 st temperature,, TR+3 stores the 4 th temperature. | ıl. |
| • WR:5 | Starting of working register for this instruction. It takes 8 registers and can't be repeated The content of WR+0 register indicates the status of the sensor which is line broken or n Bit definition of WR+0 explained as follows: | in using. ot. |
| E | Bit0 =1 indicating that the 1 st point of sensor is line broken;; Bit3=1 indicating that the ensor is line broken. | e 4 th point of |
| ● If it on tempe | Registers WR+2~WR+7 are used by this instruction. Iy needs to measure temperature, there should be a corresponding FUN72 instruction e rature module to perform the measurement. | ach for every |
| ● No ma "EN"=(| atter the FUN72 is placed in main program or in sub-program, and whether the exec 0 or 1, this instruction must be executed every scan. | ution control |
| Explanatio | n of specific registers for FUN72 | |
| ● R3968 | B~R3999 : Registers storing the primitive temperature value. R3968 storing the 1 st storing the2 nd point, etc. and R3999 storing the 32 th point. The value is fu (unipolar) or -2048~2047 (bipolar). | point, R3969 rom 0~4095 |
| ● R4014 | 4 : Time interval between the measurement points while multiplexing. Which the use The unit is in mS and the default value is 500; it means it needs 500 mS to measure temperature. This means the update rate of the temperature is 2 seconds (500mS× | r can set up. one point of 4=2000mS) |
| Wr Wr Wr | nen the value of R4014 is 250, it means it needs 250mS to measure one point of temper The update rate of the temperature is 1 second (250mS×4=1000mS) nen the value of R4014 is 1000, it means it needs 1000mS to measure one point of temp The update rate of the temperature is 4 seconds (1000mS×4=4000mS) nen the value of R4014 is 2000, it means it needs 2000mS to measure one point of temp The update rate of the temperature is 8 seconds (2000mS×4=8000mS) | ature. perature. perature. |
| R401! =0, =1, =2, =3, =4, | 5 : Times for the average of measurement, which can be set by the user. no average; every acquired value is the measured value (default) average of 2 times; the average on the acquired 2 times of values is the measured valu average of 4 times; the average on the acquired 4 times of values is the measured valu average of 8 times; the average on the acquired 8 times of values is the measured valu average of 16 times; the average on the acquired 16 times of values is the measured valu | e. e. e. alue. |
| ● R4016 | 6 : The factor for linear scaling to calculate the engineering value of K-type thermocouple positive temperature; the default value is 248. The expression for engineering value is as follows: | e while in |
| | Engineering value = (Primitive temperature value ×R4016) /1024 (Unipolar). Engineering value = (Primitive temperature value ×2×R4016) /1024 (Bipolar). | |
| Whe temp user provi | n there is a slight difference in measurement result between the standard meter and t berature module, if the user would like to use the value acquired by standard meter for car can tune the value of R4016 to get a better result in temperature measurement. ides fine tuning for positive temperature. | he FB-PLC's orrection, the This register |
| • R4017 | : The factor for linear scaling to calculate the engineering value of K-type thermocouple negative temperature; the default value is 286. The expression for engineering value is as follows: | while in |
| | Engineering value = (Primitive temperature value \times R4017) /1024 (-5 \sim 5V). | |
| When | Engineering value = (Primitive temperature value $\times 2 \times R4017$)/1024 (-10~10V). there is a slight difference in measurement result between the standard meter and t | he FB-PLC's |
| tempe | rature module, if the user would like to use the value acquired by standard meter for co | orrection, the |

When there is a slight difference in measurement result between the standard meter and the FB-PLC's temperature module, if the user would like to use the value acquired by standard meter for correction, the user can tune the value of R4017 to get a better result in temperature measurement. This register provides fine tuning for negative temperature.

| FUN 72 TP4 | Convenient instruction proper to FB-2AJ(K)4/FB-2AH(T)4 temperature module | FUN 72 TP4 |
|--------------------------|--|---------------------|
| • R4018 | 3 : The factor for linear scaling to calculate the engineering value of J-type thermocouple positive temperature; the default value is 240. | while in |
| | The expression for engineering value is as follows: | |
| | Engineering value = (Primitive temperature value $\sqrt{P}/(18)$ (1024 (Uninotar) | |
| | Engineering value = (r initiative temperature value $\sqrt{2}$, P(018) /1024 (Onipolar). | |
| Whon | there is a slight difference in measurement result between the standard meter and the stan | ha ER DI Cia |
| tompo | reference in the assurement result between the standard meter and the | arrection the |
| tempe | rature module, if the user would like to use the value acquired by standard meter for co | ster provideo |
| user o | an tune the value of R4018 to get a better result in temperature measurement. This regi | ster provides |
| fine tu | ning for positive temperature. | |
| ● R4019 | : The factor for linear scaling to calculate the engineering value of J-type thermocouple | while in |
| | negative temperature; the default value is 280. | |
| | The expression for engineering value is as follows: | |
| | Engineering value = (Primitive temperature value \times R4019) /1024 ($-5 \sim 5$ V). | |
| | Engineering value = (Primitive temperature value $\times 2 \times R4019$)/1024 (-10 \sim 10V). | |
| When | there is a slight difference in measurement result between the standard meter and t | he FB-PLC's |
| tempe | rature module, if the user would like to use the value acquired by standard meter for co | orrection, the |
| user c | an tune the value of R4019 to get a better result in temperature measurement. This regi | ster provides |
| fine tu | ning for negative temperature. | |
| • R4020 |) : High Byte of R4020 to tell the alpha value of RTD, =0, α =0.00385 (DIN) =1, α =0 |).00392 (JIS) |
| | : Low Byte of R4020 to tell where the registers storing the wire resistance for compensation | ation, |
| | =1, the wire resistance for compensation for 3-wires RTD input storing in registers R | XXX |
| | =2, the wire resistance for compensation for 3-wires RTD input storing in registers D | XXXX |
| | The starting address of above mentioned registers is storing in R4021. | |
| | The default of R4020 is 0001H. | |
| • R402 ⁻ | 1: Storing the starting address of the registers to store the wire resistance for comp | pensation for |
| | 3-wires RTD input; the default of R4021 is 8000, it means the starting register to s | tore the wire |
| | resistance for compensation is R8000 by default. The unit of the resistance is 0.1 | Ω . While in |
| | long distance measurement and the accuracy will be affected by the wire resis | tance of the |
| | connection between the RTD sensor and temperature module, under such situation, | the user has |
| | to measure the wire resistance of each loop and input them to the registers menti | oned above; |
| | otherwise, forget these. | |
| • R4022 | 2 : The factor for linear scaling to calculate the engineering value of PT-100 ; the default v | /alue is 1024 |
| | The expression for engineering value is as follows: | |
| | Engineering value = (Primitive temperature value ×R4022) /1024 | |
| • R4023 | 3 : The factor for linear scaling to calculate the engineering value of PT-1000 ; the defaul | t is 1024 |
| | The expression for engineering value is as follows: | |
| | Engineering value = (Primitive temperature value ×R4023) /1024 | |
| | When it needs to do the calibration between the standard meter and the FB-PLC's te | mperature |
| | module, the user can tune the value of R4022 or R4023 to get a better result of measured and the second sec | surement. |
| ● R4010 |) : Each bit of R4010 to tell the status of the sensor's installation. | |
| | Bit0=1 means that 1° point of temperature sensor is installed. | |
| | Bit1=1 means that 2 rd point of temperature sensor is installed. | |
| | • | |
| | | |
| | Bit15=1 means that 16" point of temperature sensor is installed. (The default of R4010 | J IS FFFFH) |
| • R401 | 1 ± 2 Each bit of R4011 to tell the status of the sensor's installation. | |
| | Bitu=1 means that 17 point of temperature sensor is installed. | |
| | Bit 1=1 means that 18 point of temperature sensor is installed. | |
| | · | |
| | • Dist E-1 means that 22 th naise of temperature concertis installed (The default of D40 | |
| | Bit 15=1 means that 32 point of temperature sensor is installed. (The default of R40 | |
| wnen | the temperature sensor is installed (the corresponding bit of R4010 or R4011 must be 1 |), the system |
| will pe | erform the line broken detection to the sensor. If there is line broken happened to the s | sensor, there |
| Will ha | ave the warning and the line broken value will be displayed. | |
| When | the temperature sensor is not installed (the corresponding bit of R4010 or R4011 mu | st be U), the |
| syster | n wont perform the line broken detection to the sensor and there will not have the | warning; the |
| tempe | erature value will be displayed as U. | |
| Deper | tus on the sensor's installation, the ladder program may control the corresponding bit of | 1 K4010 and |
| K401 | I TO TELL FOR 12 TO PERIOTATION TO THE TO THE TOKEN DETECTION. | |

| FUN 72 TP4 | Convenient instruction proper to FB-2AJ(K)4/FB- | -2AH(T)4 temperature module FUN 72 TP4 | | | | | | | |
|---------------|--|---|--|--|--|--|--|--|--|
| Program ex | Program example 1 The main unit is FBx-28MC(A), the FB-2AK4 temperature module is attached to the main unit, and the FB-2AJ4 temperature module is attached to FB-2AK4 module. The setting of polarity and span are 0~10V for both of temperature modules. ※ The analog input address for temperature measurement of FB-2AK4 is R3842. ※ The analog input address for temperature measurement of FB-2AJ4 is R3845. | | | | | | | | |
| | When M0=1, to measure the temperature of 1st (Sm=0) ~4th point of K-type thermocouple inputs and store the engineering values of measurement into R0~R3; also, store the primitive values into R3968~R3971. When there is line broken in K-type thermocouple, M1 will be ON and the line broken value of this point will be displayed. | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | | | | | |
| | When M0=1, to measure the temperature of 5th (Sm=4) ~8th point of J-type thermocouple inputs and store the engineering values of measurement into R4~R7; also, store the primitive values into R3972~R3975 When there is line broken in J-type thermocouple, M2 will be ON and the line broken value of this point will be displayed. | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | | | | |
| | When M0=1, M1000 ~ M1007 tells the status of line broken of corresponding sensor. | $-EN \begin{cases} 43.NBMV \\ S : R & 100 \\ Ns : & 0 \\ D : WM1000 \\ Nd : & 0 \end{cases}$ $43.NBMV $ | | | | | | | |
| | | -EN-S:R 108 Ns:0 D:WM1000 Nd:1 | | | | | | | |
| | | | | | | | | | |

Measuring instruction proper to FB-2AJ(K)4/FB-2AH(T)4

| FUN 72 TP4 | Convenient instruction proper to FB-2AJ(K)4 | I/FB- | 2AH(T)4 temperatu | re module | FUN 72 TP4 |
|--|---|--|--|--|--|
| Program exa | ample 2The main unit is FBx-28MC(A), the FBunit, and the FB-2AT4 temperature mare setting at 10V for both of temperat※ The analog input address for temp※ The analog input address for temp | 8-2AH odule ture n eratu eratu | 4 temperature modul is attached to FB-2A nodules. (The polarity re measurement of FI re measurement of FI | e is attached (H4 module. ⁷ is fixed at b B-2AH4 is R B-2AT4 is R | d to the main The spans ipolar). 3842. 3845. |
| M0 ● Wh 4 th g valu prim ● Wh and | en M0=1, to measure the temperature of 1^{st} (Sm=0) ~ point of PT-100 RTD inputs and store the engineering les of measurement into R0 ~ R3; also, store the nitive values into R3968~R3971. en there is line broken in PT-100 RTD, M1 will be ON the line broken value of this point will be displayed. | - EN- | 72.TP4 | RR— M LM——(| [1) |
| M0 Whn ~ 8 eng stor Whn ON disp | en M0=1, to measure the temperature of 5 th (Sm=4) s th point of PT-1000 RTD inputs and store the ineering values of measurement into R4~R7; also, the the primitive values into R3972~R3975 en there is line broken in PT-1000 RTD, M2 will be and the line broken value of this point will be played. | – EN- | 72. TP4 Tp: 3 -E Tp: 2 Sm: 4 Ym: Y 20 -A AR: R 3845 -A TR: R 4 WR: R | RR— M LM——(| 12) |
| M0 Wh stat sen: | en M0=1, M1000 \sim M1007 tells the us of line broken of corresponding sor. | -EN- | 43.NBMV S : R 100 Ns : 0 D : WM1000 Nd : 0 | | |
| | | - EN- | 43.NBMV S : R 108 Ns : 0 D : WM1000 Nd : 1 | | |
| | | | | | |

| FUN 72 TP4 | FUN 72 Convenient instruction proper to FB-2AJ(K)4/FB-2AH(T)4 temperature module TP4 Convenient instruction proper to FB-2AJ(K)4/FB-2AH(T)4 temperature module | | | | | |
|---------------|--|---------|----------------------|------------|-------|--|
| Program ex | ached. | | | | | |
| 1 | | | 08D.MOV | | 1 | |
| | a status of M000 M021 are controlled by the MMI or outerral inputs to tall the | EN - | S : WM | 800 | | |
| ● Ine | 2 Status of M800 \sim M831 are controlled by the MIVII or external inputs to tell the tus of sensor's installation; if it has the sensor perform line broken detection, and | | D:R | 4010 | | |
| not | to perform the check if it hasn't. | | - 72 TP4 | | _ | |
| M0 (lt r | needs the retentive function, so M800 \sim M1399 are the better choice). | EN- | Tn · | 0 | -ERR- | |
| • Wh | en M0=1 to measure the temperature of 1 st (Sm=0) $\sim 4^{\text{th}}$ point of K-type | 2., | Pl: | 1 | | |
| the | rmocouple inputs and store the engineering values of measurement into $R0 \sim R3$; | | Sm : | 0 | ALM- | |
| also | b, store the primitive values into $R3968 \sim R3971$. | | Ym:Y | 16 | | |
| • Wh | en there is line broken of the sensor, the value of line broken will be displayed. | | AR : R | 3842 | | |
| | | | TR:R | 100 | | |
| | | | WK:K | 100 | | |
| MO | | | ^{72.} TP4 — | | 1 | |
| | | EN - | Tp: | 0 | -ERR— | |
| • Wh | ien M0=1, to measure the temperature of 5th (Sm=4) ~ 8 th point of K-type | | PI : Sm : | 1 | | |
| the | ermocouple inputs and store the engineering values of measurement into R4 \sim R7; | | Ym:Y | 24 | -ALM- | |
| ais | b, store the phinture values into $R39/2 \sim R39/5$. | | AR : R | 3845 | | |
| ● vvr | ien there is line broken of the sensor, the value of line broken will be displayed. | | TR : R | 4 | | |
| | | | WR: R | 108 | | |
| MO | | | _ 72.TP4 — | | 7 | |
| | | EN - | Tp : | 0 | -ERR— | |
| • Wh | en M0=1, to measure the temperature of 9 th (Sm=8) \sim 12 th point of K-type | | P1 : | 1 | | |
| the | rmocouple inputs and store the engineering values of measurement into R8~R11; | | Sm : | 8 | -ALM- | |
| also | o, store the primitive values into R3976 \sim R3979. | | | 32 2949 | | |
| • Wh | en there is line broken of the sensor, the value of line broken will be displayed. | | $TR \cdot R$ | 3040 8 | | |
| | | | WR: R | 116 | | |
| | | | | |] | |
| MO | | EN- | 72.114 Tn : | 0 | -ERR- | |
| | $\sim 100-1$ to measure the temperature of 10^{th} (Ω m-10) $\sim 10^{\text{th}}$ related of 16 true | | Pl : | 1 | | |
| • wh | en MO=1, to measure the temperature of 13 (Sm=12) \sim 16 point of K-type rmocouple inputs and store the engineering values of measurement into R12 \sim R15 | e :- | Sm : | 12 | -ALM- | |
| also | o, store the primitive values into R3980 \sim R3983. | ', | Ym:Y | 40 | | |
| • Wh | en there is line broken of the sensor, the value of line broken will be displayed. | | AR:R | 3851 | | |
| | | | | 12 | | |
| | | | W K. K | 124 | | |
| MO | | | 43.NBMV | 100 |] | |
| | • | EN- | Ns: | 0 | | |
| • Wh | en M0=1, M1000~M1015 tells the line broken status of | | D : WM | 1000 | | |
| cor | responding sensor. | | Nd : | 0 | | |
| | | | 43.NBMV | | - | |
| | • | EN- | S:R | 108 | | |
| | | | NS: | 1000 | | |
| | | | Nd · | 1000 | | |
| | | | _ 42 NIDMAY | - | | |
| | | EN- | S : R | 116 | | |
| | | | Ns : | Ō | | |
| | | | D :WM | 1000 | | |
| | | | Nd : | 2 | | |
| | | | 43.NBMV | | 1 | |
| | | EN- | S:R Ns· | 124 0 | | |
| | | | D :WM | 1000 | | |
| | | | Nd : | 3 | | |
| ' | | | | | - | |

| FUN 72 TP4 | FUN 72 TP4 Convenient instruction proper to FB-2AJ(K)4/FB-2AH(T)4 temperature module | | | | | |
|---|---|--------|--|---------------------------|----------------|--|
| Program example 4 The main unit is FBx-40MC(A), and 4 modules of FB-2AH4 are attached. The spans are all setting at 5V (FB-2AH4 supports bipolar only). | | | | | | |
| • The state | e status of M800 \sim M831 are controlled by the MMI or external inputs to tell the us of sensor's installation; if it has the sensor, perform line broken detection, | - EN - | 08D.MOV S : WM D : R | 800 4010 | | |
| M0 and ↓ ↓ ↓ (It n | not to perform the check if it hasn't. eeds the retentive function, so M800 \sim M1399 are the better choice). | - EN- | 72.TP4 — Tp : Pl : | 2 3 | -ERR— | |
| ● Whe inpu the | en M0=1, to measure the temperature of 1 st (Sm=0) \sim 4 th point of PT-100 RTD its and store the engineering values of measurement into R0 \sim R3; also, store primitive values into R3968 \sim R3971. | | Sm : Ym : Y AR : R | 0 16 3842 | -ALM— | |
| • Who | en there is line broken of the sensor, the value of line broken will be displayed. | | TR : R WR: R | 0 100 | | |
| Who Who inpu the | en M0=1, to measure the temperature of 5 th (Sm=4) \sim 8 th point of PT-100 RTD its and store the engineering values of measurement into R4 \sim R7; also, store primitive values into R3972 \sim R3975. | -EN - | Tp : Pl : Sm : Ym: Y AR : R | 2 3 4 24 3845 | -ERR— -ALM— | |
| • Who | en there is line broken of the sensor, the value of line broken will be displayed. | | TR : R WR: R 72.TP4 — | 4 108 | | |
| When the particular terms of te | en M0=1, to measure the temperature of 9 th (Sm=8) \sim 12 th point of PT-100 RTD its and store the engineering values of measurement into R8 \sim R11; also, store primitive values into R3976 \sim R3979. | -EN - | Tp: Pl: Sm: Ym:Y AR:R | 2 3 8 32 3848 | -ERR— -ALM— | |
| • Who M0 | en there is line broken of the sensor, the value of line broken will be displayed. | | TR : R WR: R 72.TP4 — | 8 116 |] | |
| Whe RTE store | en M0=1, to measure the temperature of 13^{th} (sm=12) $\sim 16^{\text{th}}$ point of PT-100 D inputs and store the engineering values of measurement into R12 \sim R15; also, e the primitive values into R3980 \sim R3983. | – EN - | Tp: Pl: Sm: Ym:Y | 2 3 12 40 | -ERR— -ALM— | |
| • Wh | en there is line broken of the sensor, the value of line broken will be displayed. | | $\frac{AK:K}{TR:R}$ $WR:R$ $= 43 \text{ NBMV}$ | 12 124 | | |
| Whe Corr | en M0=1, M1000 \sim M1015 tells the line broken status of esponding sensor. | – EN - | S : R Ns : D : WM Nd : | 100 0 1000 0 | | |
| | | - EN- | A3.NBMV S : R Ns : D : WM Nd : | 108 0 1000 1 | | |
| | | - EN - | 43.NBMV S : R Ns : D : WM Nd : | 116 0 1000 2 | | |
| | | - EN - | A3.NBMV S : R Ns : D : WM Nd : | 124 0 1000 3 | | |

| FUN 73 TSTC | Conv | Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | | | | | FUN 73 TSTC | | |
|---------------------------|---------|---|-------|------------|--|--|--|--|--|
| 73.TSTC | | | | | | | | | |
| Execution control—EN-Tp : | | | | | - ERR — Parameter error | | | | |
| Heating/Cooli | ing—H/ | /C-P1 : | | | -AO0-Senso | or line broken | | | |
| | | Sm : | | | -AO1—Warn | ing indication | | | |
| | | Ym: | | | | | | | |
| | | AR : | | | | | | | |
| | | TR : | | | | Tp : Type of sensor | | | |
| | | Yh : | | | =0, K-type thermocouple =1. J-type thermocouple | | | | |
| | | Sh : | | | | =2, PT-100 RTD | | | |
| | | Zh : | | | | =3, PT-1000 RTD | | | |
| | | Sv : | | | | PI : Setting of polarity and span =0. 0 \sim 10V (Unipolar) | | | |
| | | Os : | | | | =1, 0 \sim 5V (Unipolar) | | | |
| | | PR : | | | | =2, $-10 \sim 10V$ (Bipolar =3, $-5 \sim 5V$ (Bipolar) | | | |
| | | IR : | | | | Unipolar: U/B jumper set at U | | | |
| | | DR : | | | | Bipolar: U/B jumper set at B Span :5V/10V jumper setting | | | |
| | | OR : | | | | Sm : Starting point of temperature mea | surement of | | |
| | | WR: | | | | this module. Sm= $0, 4, 8, \dots, 28$ | | | |
| | | | | | | Ym : Starting address of discrete output | ut of this | | |
| | | | | | | module for multiplexing temperatu | ire input; it | | |
| | | | | | | discrete output will be installed af | ter the | | |
| | | | | | | temperature module, the discrete | output 3 | | |
| Range | Y HF | R IR | DR | ROR | К | AR : Address of analog input for tempe | rature | | |
| Ope- Y | r0 R0 | R3840 | D0 | R5000 | | measurement of this module; whi analog input. When expansion mo | ch is the 3 [™] odule with | | |
| rand Y2 | 255 R38 | 39 R3903 | D3071 | R8071 | | analog input will be installed after | the | | |
| Тр | | | | | 0~3 | which must be added 3. | iddress of | | |
| Sm | | | | | $n \times 4$ n=0~7 | TR : Starting register of the engineerin | g value of | | |
| Ym (| С. | | | | | temperature measurement, 4 regi | sters in total. | | |
| TR | 0 |) | 0 | * | | it takes Zh points. | aipai, | | |
| Yh (| 0 | | | | 021 | Sh : Starting point of PID control of this Sh = $0 \sim 31$ | instruction; | | |
| Zh | | | | | 1~32 | Zh : Number of the PID control of this in | nstruction; | | |
| Sv | 0 |) | 0 | O* | | 1≤Zh≤32 and 1≤Sh+Zh≤32 | | | |
| PR | 0 |) | 0 | 0* 0* | | it takes Zh registers. | | | |
| IR | 0 |) | 0 | O * | | Os : Starting register of the in-zone offs | set; | | |
| DR OR | 0 |) | 0 | * * | | It takes Zh registers. PR : Starting register of the gain (Kc): | | | |
| WR | 0 |) | Õ | Ŭ* | | it takes Zh registers. | | | |
| | | | | | | IR : Starting register of integral tuning o it takes Zh registers. | constant (Ti); | | |
| | | | | | | DR : Starting register of derivative tunir (Td); it takes Zh registers. | ng constant | | |
| | | | | | | OR : Starting register of the PID analog | j output; | | |
| | | | | | | WR : Starting of working register for thi | s instruction. | | |
| | | | | | | It takes 17 registers and can't using. | be repeated in | | |
| | | | | | | 5 | | | |

FUN 73 FUN 73 Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 TSTC TSTC Function guide and notifications FUN73 Convenient instruction combines the temperature measurement with PID control and it is dedicated for the modules of FB-2AJ(K)4 and FB-2AH(T)4. FB-2AJ(K)4/FB-2AH(T)4 multiplexing temperature module occupies 3 points of analog input address and 8 points of discrete output address in physical, more detail as followings: • FB-2AJ4 provides 2 points of general purpose analog inputs (1st and 2nd analog input) and 4 points of J-type thermocouple inputs for temperature measurement (With the combination of 3rd analog input and 8 points of discrete output making 4 points of temperature measurement). • FB-2AK4 provides 2 points of general purpose analog inputs (1st and 2nd analog input) and 4 points of K-type thermocouple inputs for temperature measurement (With the combination of 3rd analog input and 8 points of discrete output making 4 points of temperature measurement). • FB-2AH4 provides 2 points of general purpose analog inputs (1st and 2nd analog input) and 4 points of 3-lines PT-100 RTD inputs for temperature measurement (With the combination of 3rd analog input and 8 points of discrete output making 4 points of temperature measurement). • FB-2AT4 provides 2 points of general purpose analog inputs (1st and 2nd analog input) and 4 points of 3-lines PT-1000 RTD inputs for temperature measurement (With the combination of 3rd analog input and 8 points of discrete output making 4 points of temperature measurement). • The selection of input span of FB-2AJ(K)4 temperature module can be 5V (500°C) (when jumper setting at the position of 5V) or 10V (1000°C)(when jumper setting at the position of 10V); the input polarity can be set as unipolar (U/B jumper setting at U) or bipolar (U/B jumper setting at B): When setting at10V(1000°C) and unipolar, the range of measurement is 0°C~750°C (J-type) or 0°C~900°C (K-type) When setting at 5V(500°C) and unipolar, the range of measurement is 0°C~420°C (J-type) or 0°C~450°C (K-type) When setting at 10V(1000°C) and bipolar, the range of measurement is -200°C~750°C (J-type) or -200°C~900°C(K-type) When setting at 5V(500°C) and bipolar, the range of measurement is -200°C~420°C (J-type) or -200°C~450°C(K-type) • The selection of input span of FB-2AH(T)4 temperature module can be 5V (when jumper setting at the position of 5V) or 10V (when jumper setting at the position of 10V); the input polarity is fixed for bipolar : When setting at 10V, the range of measurement is -49.8°C~146.6°C (DIN) or -50.7°C~149.2°C (JIS) When setting at 5V. the range of measurement is -12.3°C~83.6°C (DIN) or -12.5°C~85.1°C (JIS) • FB-2AJ(K)4/FB-2AH(T)4 multiplexing temperature module occupies 3 points of analog input address and 8 points of discrete output address in physical; · when expansion module with analog input will be installed after this kind of module, the analog address of which must be added 3: • when expansion module with discrete output will be installed after this kind of module, the discrete output address of which must be added 8. • Modules FB-2AJ(K)4/FB-2AH(T)4 can't be used together with module FB-8AD or FB-4AJ(K)××. • For the selection of thermocouple, K-type thermocouple is recommended. It is recommended to select 0~5V for the span and polarity of input if it meets the requirement. • Connect the "FG" terminal with the shielding of thermocouple if it is with for better measurement. • The G = m terminal must be connected to the safty earth ground of the power system.

| FUN 73 | FUN 73 |
|--|--------|
| TSTC Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | TSTC |

- Fun73 instruction employs the multiplexing temperature module [FB-2AJ(K)4/FB-2AH(T)4] to get the current value of temperature and let it be as so called Process Variable (PV); after the calculation of software PID expression, it will respond the error with an output signal according to the setting of Set Point (SP), the error's integral and the rate of change of the process variable. Through the closed loop operation, the steady state of the process may be expected.
- Convert the output of PID calculation to be the time proportional on/off (PWM) output, and via transistor output to control the SSR for heating or cooling process; this is a good performance and very low cost solution.
- Through the analog output module (D/A module), the output of PID calculation may control the SCR or proportional valve to get more precise process control.
- Digitized PID expression is as follows:

$$Mn = [Kc \times En] + \sum_{0}^{n} [K_c \times T_i \times T_s \times E_n] - [K_c \times T_d \times (PV_n - PV_{n-1})/T_s]$$

Where,

- Mn : Output at time "n".
- Kc : Gain (Range: 1~999 ; Pb=100(%) / Kc)
- Ti : Integral tuning constant (Range:0~999, equivalent to 0.00~9.99 Repeat/Minute)
- Td : Derivative tuning constant (Range:0~999, equivalent to 0.00~9.99 Minute)

PVn: Process variable at time "n"

PV n-1: Process variable when loop was last sovled

En : Error at time "n" ; E= SP – PVn

Ts : Solution interval for PID calculation (Valid value are 10, 20, 40, 80 ;the unit is in 0.1Sec)

| FUN 73 TSTC | Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | FUN 73 TSTC | | | | | |
|--|--|--|--|--|--|--|--|
| Principle of I | PID parameter adjustment | | | | | | |
| As the obtain Do the proces | Principle of PID parameter adjustment As the gain (Kc) adjustment getting larger, the larger the proportional contribution to the output. This can obtain a sensitive and rapid control reaction. However, when the gain is too large, it may cause oscillation. Do the best to adjust "Kc" larger (but not to the extent of making oscillation), which could increase the process reaction and reduce the steady state error | | | | | | |
| ● Integra consta "Ti" lar When For ex | al item may be used to eliminate the steady state error. The larger the number (Ti, in nt), the larger the integral contribution to the output. When there is steady state error ger to decrease the error. the "Ti" = 0, the integral item makes no contribution to the output. a. if the reset time is 6 minutes. Ti=100/6=17; if the integral time is 5 minutes. Ti=100/5 | tegral tuning or, adjust the =20. | | | | | |
| Deriva numbe too ove When For ex | tive item may be used to make the process smoother and not too over shoot. Ther (Td, derivative tuning constant), the larger the derivative contribution to the output. Wer shoot, adjust the "Td" larger to decrease the amount of over shoot. the "Td" = 0, the derivative item makes no contribution to the output. a, if the rate time is 1 minute, then the Td = 100; if the differential time is 2 minute, then the tot adjust the PID parameters can obtain an excellent result for temperature control | the larger the When there is the Td = 200. | | | | | |
| The de | adjust the rab parameters can obtain an excellent result for temperature control. | | | | | | |
| Whe | n the setting of span and polarity of the module is $0 \sim 10V$, the default of gain (Kc) is 6 | 0. | | | | | |
| Whe | n the setting of span and polarity of the module is $0 \sim 5V$, the default of gain (Kc) is 30 | J_ | | | | | |
| Whe | n the setting of span and polarity of the module is $-10 \sim 10V$, the default of gain (Kc) is | i 120. | | | | | |
| Whe | n the setting of span and polarity of the module is -5 \sim 5V, the default of gain (Kc) is 60 | 0. | | | | | |
| • The de | efault of integral tuning constant is 17, it mens the reset time is 6 minutes (Ti=100/6=17) | | | | | | |
| The dependence | efault of derivative tuning constant is 100, it means the rate time is 1 minutes (Td=100). | | | | | | |
| | | | | | | | |
| User guide t | o Convenient instruction FUN73 | | | | | | |
| FB-2AJ(ł | ()4 temperature module: | | | | | | |
| When | execution control "EN"=1, this instruction will perform multiplexing temperature meas | urement and | | | | | |
| SIDIE 1 | (TP31): the value falls in $0 \sim 4095$ (uninolar) or $-2048 \sim 2047$ (bipolar) And then have a | 990(1F20) | | | | | |
| of tem values | perature sensor (Tp), input span and polarity (PI) of the temperature module to scale to engineering values and store them to temperature measurement registers (TR+ | the primitive 0 as the 1 st | | | | | |
| point, | , TR+3 as the 4 th point). | | | | | | |
| FB-ZAH(| r)4 temperature module: | uromont and | | | | | |
| base c scale (TR+0 4095 a R3999 | the setting of temperature sensor (Tp), input span and polarity (PI) of the temperature measurem the primitive values to engineering values and store them to temperature measurem as the 1 st point,, TR+3 as the 4 th point). Then scale the engineering values by the and store them into R3968(TP0)~R3971(TP3) or R3972(TP4)~3975(TP7),or R3 ^o (TP31); the value falls in 0~4095. | re module to ent registers range of $0 \sim$ 996(TP28) \sim | | | | | |
| When "ERR" | the setting of Tp, PI, Sm comes error, this instruction will not be performed and the outp will be ON. | out indication | | | | | |
| When | the sensor is K-type thermocouple (it needs FB-2AK4 module): | | | | | | |
| 1. As t Whe | he setting of input span and polarity is $0 \sim 10$ V, the range of measurement will be $0 \sim 90$ on the display value is greater than 900°C, it means the line broken of the thermoco- out indication "AOO" will be ON | 0°C. uple and the | | | | | |
| 2. As t | he setting of input span and polarity is $0 \sim 5V$, the range of measurement will be $0 \sim 450$ | °C | | | | | |
| Whe | en the display value is greater than 450°C, it means the line broken of the thermoco | uple and the | | | | | |
| outp | put indication "AO0" will be ON. | - | | | | | |
| 3. As t Whe | the setting of input span and polarity is -10 \sim 10V, the range of measurement will be - ten the display value is greater than 900°C, it means the line broken of the thermocor- put indication "AO0" will be ON. | 200 \sim 900°C. uple and the | | | | | |
| 4. As Whe | the setting of input span and polarity is $-5 \sim 5V$, the range of measurement will be - en the display value is greater than 450°C, it means the line broken of the thermocolout indication "AO0" will be ON. | 200 \sim 450°C. uple and the | | | | | |

| FUN 73 TSTC | Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | FUN 73 TSTC | | | | |
|--|---|--|--|--|--|--|
| • When 1. As Wi | When the sensor is J-type thermocouple (it needs FB-2AJ4 module): 1. As the setting of input span and polarity is 0~10V, the range of measurement will be 0~750°C. When the display value is greater than 900°C, it means the line broken of the thermocouple and the | | | | | |
| 2. As | the setting of input span and polarity is $0 \sim 5V$, the range of measurement will be $0 \sim 42$ hen the display value is greater than 450°C, it means the line broken of the thermoco- tput indication "AO0" will be ON. | 0°C. uple and the | | | | |
| 3. As Wi | the setting of input span and polarity is $-10 \sim 10$ V, the range of measurement will be -2 hen the display value is greater than 900°C, it means the line broken of the thermocol tput indication "AO0" will be ON. | 200 \sim 750°C. uple and the | | | | |
| 4. As Wi the | the setting of input span and polarity is $-5 \sim 5V$, the range of measurement will be -5 hen the displayed temperature value is greater than 450°C, it means the line bremocouple and the output indication "AO0" will be ON. | $200 \sim 420^{\circ}$ C. oken of the | | | | |
| • When 1. As -4! | the sensor is RTD type of PT-100 (it needs FB-2AH4) or PT-1000 (it needs FB-2AT4): the setting of input span is $-10 \sim 10V$, the range of measurement will be $9.8^{\circ}C \sim 146.6^{\circ}C$ (DIN) or $-50.7^{\circ}C \sim 149.2^{\circ}C$ (JIS) | | | | | |
| 2. As -12 3.Wh | the setting of input span is -10 \sim 10V, the range of measurement will be 2.3°C \sim 83.6°C (DIN) or -12.5°C \sim 85.1°C (JIS) on the display value is greater than 900.0°C, it means the line broken of the sensor ar | nd the output | | | | |
| inc | lication "AO0" will be ON. | | | | | |
| Note: WI | hen there exists the line broken of the sensor, it can be told from the content of Wi gister which tells the input point(s) of line broken. | R+0 working | | | | |
| • Sm: S | . It must be the multiple of 4 | 0≤Sm≤28. | | | | |
| • Ym: S | starting address of discrete output of this module for multiplexing temperature input; takes 8 points of discrete output. | | | | | |
| • AR: A | ddress of analog input (3 rd) for temperature measurement of this module. | | | | | |
| • TR : S | Starting register of the engineering value of temperature measurement, 4 registers in tota R+0 stores the 1 st temperature,, TR+3 stores the 4 th temperature. | al. | | | | |
| PID or | peration will begin after FUN73 has measured the temperature of every point. | | | | | |
| When (H/C= multipl are st respon of cha (PWM good p registe as to g | execution control "EN" = 1, it depends on the input status of H/C for PID operation to n 1) or cooling (H/C=0) control. The current values of measured temperature are lexing temperature module $[FB-2AJ(K)4/FB-2AH(T)4]$ to get; the set points of desired ored in the registers starting from Sv. With the calculation of software PID expre- nd the error with an output signal according to the setting of setpoint, the error's integral nge of the process variable. Convert the output of PID calculation to be the time propo) output, and via transistor output to control the SSR for heating or cooling process; whe performance and very low cost solution. It may also apply the output of PID calculation ers starting from OR), by way of D/A analog output module, to control SCR or proportio get more precise process control. | nake heating through the temperature ssion, it will and the rate rtional on/off ere there is a on (stored in nal valve, so | | | | |
| When | Sh, Zh setting error, this instruction will not be executed and the instruction output "ERR | " will be ON. | | | | |
| This ir falls w the in- instruct | nstruction compares the current value with the set point to check whether the current ithin deviation range (stored in register starting from Os). If it falls in the deviation ran- zone bit of that point to be ON; if not, clear the in-zone bit of that point to be OFF stion output "AO1" ON. | temperature ge, it will set ⁻ , and make | | | | |
| In the set po curren warnir arouse | mean time, this instruction will also check whether highest temperature warning (the re- bint of highest temperature warning is R4008). When successively scanning for te t values of measured temperature are all higher than or equal to the highest warning s ing bit will set to be ON and instruction output "AO1" will be on. This can avoid the sa ed from temperature out of control, in case the SSR or heating circuit becomes short. | gister for the in times the set point, the fety problem | | | | |
| This ir open, R4006 tempe | nstruction can also detect the unable to heat problem resulting from the SSR or heating or the obsolete heating band. When output of temperature control turns to be large p o register) successively in a certain time (set in R4007 register), and can not m rature fall in desired range, the warning bit will set to be ON and instruction output "AO1 | j circuit runs ower (set in nake current " will be ON. | | | | |

| FUN 73 TSTC | Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | FUN 73 TSTC |
|--|--|---|
| Yh : S Sh : S Zh : N Sv : S Os : S PR : S IR : S | Starting address of PID ON/OFF output; it takes Zh points Starting point of PID control of this instruction; where $0 \le Sh \le 31$. Number of the PID control of this instruction; where $1\le Zh\le 32$ and $1\le Sh+Zh\le 32$ Starting register of the setpoint; it takes Zh registers. Starting register of the in-zone offset; it takes Zh registers. Starting register of the gain (Kc); it takes Zh registers. Starting register of integral tuning constant (Ti); it takes Zh registers | |
| • DR : S • OR : S • WR : S T E | Starting register of derivative tuning constant (Td); it takes Zh registers. Starting register of the PID analog output; it takes Zh registers. Starting of working register for this instruction. It takes 17 registers and can't be repeated The content of WR+0 register indicates the status of the sensor which is line broken or no Stit definition of WR+0 explained as follows: Bit0=1 indicating that the Sm+0 point of sensor is line broken Bit3=1 indicating that the Sm+3 point of sensor is line broken. | l in using. ot. |
| in Bi E | the content of the two registers WR+8 and WR+9 indicating that whether the current tem ithin the deviation range (stored in registers starting from Os). If it falls in the deviation- zone bit of that point will be set ON; if not, the in-zone bit of that point will be cleared Of t definition of WR+8 explained as follows: Bit0=1, it represents that the temperature of the Sh+0 point is in-zone Bit15=1, it represents that the temperature of the Sh+15 point is in-zone. | Frature fails on range, the Fr. |
| Bi E E | t definition of WR+9 explained as follows: it0=1, it represents that the temperature of the Sh+16 point is in-zone… bit15=1, it represents that the temperature of 32th point is in-zone. | |
| Tł W Bi | ne content of the two registers WR+10 and WR+11 are the warning bit registers, they hether there exists the highest temperature warning or heating circuit opened. | indiacte that |
| E | Bit0=1, it means that there exists the highest warning or heating circuit opened at the Sh- Bit15=1, it means that there exists the highest warning or heating circuit opened at the S It definition of WR+11 explained as follows: | ⊦0 point h+15 point. |
| E | Bit0=1, it means that there exists the highest warning or heating circuit opened at the Sh- Bit15=1, it means that there exists the highest warning or heating circuit opened at the 3 | ⊦16 point 32th point. |
| • This ir sensoi • Wheth instruct | egisters of WR+2~WR+7 and WR+12~WR+16 are used by this instruction. Instruction can only be used to perform heating or cooling control of positive temperature is the thermocouple. In the FUN73 is placed in main or sub program and no matter the execution control "EN stion must be executed at every scan. | ure while the I"=0 or 1, this |
| Specific regi | isters related to instruction of FUN73 | |
| R4014 When the up When the up | Time interval between the measurement points while multiplexing. Which the user The unit is in mS and the default value is 500; it means it needs 500mS to measure temperature. This means the update rate of the temperature is 2 seconds (500mS× the value of R4014 is 250, it means it needs 250mS to measure one point of temperatu date rate of the temperature is 1 second (250mS×4=1000mS). the value of R4014 is 1000, it means it needs 1000mS to measure one point of temperature date rate of the temperature is 4 second (1000mS×4=4000mS). | can set up. one point of 4=2000mS) re; ature; |

When the value of R4014 is 2000, it means it needs 2000mS to measure one point of temperature; the update rate of the temperature is 4 second ($2000mS \times 4=8000mS$).

| FUN 73 TSTC | Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | FUN 73 TSTC |
|---|--|--|
| R4015 =0, =1, =2, =3, =4, R4016 When tempe user confine tu R4017 When tempe user confine tu R4017 | : Times for the average of measurement, which can be set by the user. no average ; every acquired value is the measured value (default) average of 2 times; the average on the acquired 2 times of values is the measured value average of 4 times; the average on the acquired 4 times of values is the measured value average of 8 times; the average on the acquired 8 times of values is the measured value average of 16 times; the average on the acquired 16 times of values is the measured value average of 16 times; the average on the acquired 16 times of values is the measured value average of 16 times; the default value is 248. The expression for engineering value positive temperature; the default value = (Original temperature value $\times 2\times R4016$) /1024 (U Engineering unit temperature value = (Original temperature value $\times 2\times R4016$) /1024 (U Engineering unit temperature value = (Original temperature value $\times 2\times R4016$) /1024 (U Engineering unit temperature value = (Original temperature value $\times 2\times R4016$) /1024 there is a slight difference in measurement result between the standard meter for co an tune the value of R4016 to get a better result in temperature measurement. This regining for positive temperature. : The factor for linear scaling to calculate the engineering value of K-type thermocouple negative temperature; the default value is 286. The expression for engineering value i Engineering value = (Primitive temperature value $\times 2\times R4017$) /1024 ($-5 \sim 5V$). Engineering value = (Primitive temperature value $\times 2\times R4017$) /1024 ($-10 \sim 10V$). there is a slight difference in measurement result between the standard meter and t rature module, if the user would like to use the value acquired by standard meter and t rature module, if the user would like to use the value acquired by standard meter and t rature module, if the user would like to use the value acquired by standard meter for co an tune the value of R4017 to get a better result in temperature measurement. This regin there is a slight difference in measurement | A. < |
| user c fine tu ● R4018 When tempe | an tune the value of R4017 to get a better result in temperature measurement. This reginning for negative temperature. b): The factor for linear scaling to calculate the engineering value of J-type thermocouple positive temperature; the default value is 240. The expression for engineering value is as follows: Engineering value = (Primitive temperature value ×R4018) /1024 (Unipolar). Engineering value = (Primitive temperature value ×2×R4018) /1024 (Bipolar). there is a slight difference in measurement result between the standard meter and t rature module, if the user would like to use the value acquired by standard meter for calculate the value of R4018 to get a better result in temperature measurement. This reginal is the value of R4018 to get a better result in temperature measurement. | ter provides while in the FB-PLC's prrection, the ster provides |
| fine tu • R4019 | ning for positive temperature. The factor for linear scaling to calculate the engineering value of J-type thermocouple negative temperature; the default value is 280. The expression for engineering value is as follows: Engineering value = (Primitive temperature value ×R4019) /1024 (-5~5V). Engineering value = (Primitive temperature value ×2×R4019) /1024 (-10~10V). | e while in |
| When tempe user c fine tu ● R4020 | there is a slight difference in measurement result between the standard meter and t erature module, if the user would like to use the value acquired by standard meter for ca an tune the value of R4019 to get a better result in temperature measurement. This regi- ning for negative temperature. : High Byte of R4020 to tell the alpha value of RTD, =0, $\alpha = 0.00385$ (DIN) =1, $\alpha = 0.00385$: Low Byte of R4020 to tell where the registers storing the wire resistance for compensa =1, the wire resistance for compensation for 3-wires RTD input storing in registers Ra =2, the wire resistance for compensation for 3-wires RTD input storing in registers D The starting address of above mentioned registers is storing in R4021. | he FB-PLC's prrection, the ster provides 00392 (JIS) ation, xxxx xxxx |
| R4021 P4022 | The default of R4020 is 0001H. Storing the starting address of the registers to store the wire resistance for comp 3-wires RTD input; the default of R4021 is 8000, it means the starting register to s resistance for compensation is R8000 by default. The unit of the resistance is 0.11 long distance measurement and the accuracy will be affected by the wire resis connection between the RTD sensor and temperature module, under such situation, to measure the wire resistance of each loop and input them to the registers menti otherwise, forget these. The factor for linear scaling to calculate the engineering value of RT 100 : the default being the sensor and temperature value of RT 100 : the default being the sensor and the accuracy value of RT 100 : the default being the sensor and the accuracy value of RT 100 : the default being the sensor and the accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the sensor accuracy value of RT 100 : the default being the sensor accuracy value of RT 100 : the sensor accuracy value of R | pensation for tore the wire Ω . While in tance of the the user has oned above; |
| R4022 R4023 | The factor for innear scaling to calculate the engineering value of PT-100; the default of The expression for engineering value is as follows: Engineering value = (Primitive temperature value ×R4022) /1024 The factor for linear scaling to calculate the engineering value of PT-1000; the default of the expression for engineering value is as follows: Engineering value = (Primitive temperature value ×R4023) /1024 When it needs to do the calibration between the standard meter and the FB-PLC's termodule, the user can tune the value of R4022 or R4023 to get a better result of measure | t is 1024 nperature urement. |

| FUN 73 TSTC | Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | FUN 73 TSTC |
|---|--|--|
| • R4010 | Each bit of R4010Bit15=1 means that to tell the status of the sensor's installation. Bit0=1 means that 1st point of temperature sensor is installed. Bit1=1 means that 2nd point of temperature sensor is installed. | |
| • R4011 | Bit15=1 means that 16th point of temperature sensor is installed. (The default of R4010 is FFFFH) R4011 : Each bit of R4011 to tell the status of the sensor's installation. Bit0=1 means that 17th point of temperature sensor is installed. Bit1=1 means that 18th point of temperature sensor is installed. | |
| When will pe will ha When systen tempe Deper R4011 R4005 | Bit15=1 means that 32 nd point of temperature sensor is installed. (The default of R4011 is FFFFH) the temperature sensor is installed (the corresponding bit of R4010 or R4011 must be 1 rform the line broken detection to the sensor. If there is line broken happened to the ve the warning and the line broken value will be displayed. the temperature sensor is not installed (the corresponding bit of R4010 or R4011 mu n won't perform the line broken detection to the sensor and there will not have the rature value will be displayed as 0. dos on the sensor's installation, the ladder program may control the corresponding bit of to perform or not to perform the line broken detection. |), the system sensor, there ist be 0), the warning; the of R4010 and |
| | =0, perform the PID calculation evey 2 seconds (System default). =1, perform the PID calculation evey 4 seconds. =2, perform the PID calculation evey 8 seconds. ≥3, perform the PID calculation evey 1 second. (R4014 must be 250 to make sense) : The content of High Byte to define the cycle time of PID ON/OFF (PWM) output. =0 · PWM cycle time is 2 seconds (system default) =1 · PWM cycle time is 4 seconds. |) |
| Note 1 : V ti Note 2 : c ti R4006 | =2 · PWM cycle time is 8 seconds. ≥3 · PWM cycle time is 1 second. When changing the value of R4005, the execution control "EN" of FUN73 must be set at me when execution control "EN" =1, it will base on the latest set point to perform the PII The smaller the cycle time of PWM, the more even can it perform the heating. Howe aused by the PLC scan time will also become greater. For the best control, it can bas me of PLC to adjust the solution interval of PID calculation and the PWM cycle time. 5 : The setting point of large power output detection for SSR or heating circuit opened, or obsolete. The unit is in % and the setting range falls in 80~100(%); system default ': The setting time to detect the continuing duration of large power output while SSR or opened, or heating band obsolete. The unit is in second and the setting range falls i (seconds); system default is 600 (seconds). | t 0. The next D calculation. ever, the error se on the scan r heating band is 90(%). heating circuit n $300 \sim 65535$ |
| R4008R4012 | B: The setting point of highest temperature warning for SSR, or heating circuit short de unit is in degree and the setting range falls in 50~65535; system default is 350 (degree in the setting range falls in 50~65535; system default is 350 (degree in the setting range falls in 50~65535; system default is 350 (degree in the setting range falls in 50~65535; system default is 350 (degree in the setting range falls in 50~65535; system default is 350 (degree in the setting range falls in the settin | etection. The rees). |
| • R4013 | (The default of R4012 is FFFH) 3: Each bit of R4013 to tell the need of PID temperature control. Bit0=1 means that 17 th point needs PID temperature control. Bit1=1 means that 18 th point needs PID temperature control. ••• Bit15=1 means that 32 nd point needs PID temperature control. (The default of P1012 is EFFEL) | |
| While bit of F calcula While bit of point v | execution control "EN"=1 and the corresponding bit of PID control of that point is ON (c R4012 or R4013 must be 1), the FUN73 instruction will perform the PID operation and re ation with the output signal. execution control "EN"=1 and the corresponding bit of PID control of that point is OFF (c R4012 or R4013 must be 0), the FUN73 will not perform the PID operation and the c vill be OFF. | orresponding espond to the orresponding output of that |
| The land not to be ide | dder program may control the corresponding bit of R4012 and R4013 to tell the FUN73 perform the PID control, and it needs only one FUN73 instruction. (The temperature ntical in sensor type and the setting of input span and polarity must be the same.) | to perform or module must |

| FUN 73 TSTC | Convenient instruction of PID temperature control for FB-2AJ(K)4/FE | 3-2AH(T)4 | FUI TS | N 73 STC |
|--|---|--|--------------------------------|-------------------------------|
| Program ex | tample 1 The main unit is FBx-40MC(A) ,and 4 temperature modules of The settings of input span and polarity are all at $0 \sim 10$ V. | of FB-2AK4 | are atta | iched. |
| *** It takes of modules *** When pe system of | only one FUN73 instruction to perform 16 points of PID temperature cont are identical in sensor type and the settings of input span and polarity are the rforming the FUN73 instruction of the first time, the system will automatical default of gain (Kc), integral tuning constant (Ti), and derivative tuning con- | rol when th ne same. ly assign to stant (Td), o | e tempe each po etc. The | erature oint its e user |
| may cha | nge the settings if necessary. | | | |
| | E | $N = \begin{bmatrix} 08D.MOV \\ S : WM \\ B \end{bmatrix}$ | 800 | |
| • 1 s a | The status of M800 \sim M831 are controlled by the MMI or external inputs to tell the status of sensor's installation; if it has the sensor, perform line broken detection, and not to perform the check if it hasn't. | D : K | 4010 | |
| (• V | When temperature sensor installed (the corresponding bit of R4010 or R4011 is 1) and sensor, the line broken value of that point will be displayed. | I there is line | broken o | f the |
| ● V t | When temperature sensor is not installed (the corresponding bit of R4010 or R4011 is he line broken detection; the temperature of that point is displayed 0. | s 0), there w | ill not per | form |
| | | - 08D.MO | / | |
| + | E | N S : WM | 832 | |
| ● T v c | The status of M832 \sim M863 are controlled by the MMI or external inputs to tell whether it needs the PID control of the corresponding point; perform the PID opperation when the bit is ON, and not to perform if it is OFF (It needs the retentive function, so M800 \sim M1399 are the better choice). | D : R | 4012 | |
| • V | When temperature control bit is ON (the corresponding bit of R4012 or R4013 is 1), operation of that point to obtain a suitable output signal. | FUN73 perf | orms the | PID |
| ● V F | When temperature control bit is OFF (the corresponding bit of R4012 or R4013 is 0), I PID operation of that point and output will be OFF. | FUN73 will n | ot perform | 1 the |
| M3 | | $\begin{bmatrix} 72.\text{TP4} - \\ \text{Tp} \end{bmatrix}$ | 0 | |
| | E | $N = \frac{1p}{Pl}$ | 0 | ERR— |
| th | nermocouple inputs and store the engineering values of measurement into R12 \sim | Sm: Ym: Y | 12 40 | ALM- |
| • 1 | Vhen there is line broken of the sensor, the value of line broken will be displayed. | AR: R | 3851 | |
| | | WR: R | 12 240 | |
| M3 | | 72.TP4 — | | |
| + −− | —————————————————————————————————————— | N-Tp: | 0 | ERR— |
| • V | when M3=ON, to measure the temperature of 9^{m} (Sm=8) $\sim 12^{m}$ point of K-type | Sm : | 8 | ALM- |
| R | R11; also, store the primitive values into R3976 \sim R3979. | Ym: Y | 32 | |
| • W | /hen there is line broken of the sensor, the value of line broken will be displayed. | AR: R TR: R | 3848 | |
| | | WR: R | 230 | |
| М3 | | 72.TP4- | | |
| | E | N-1p: P1: | 0 | ERR— |
| th | ermocouple inputs and store the engineering values of measurement into R4 \sim R7; | Sm : | 4 | ALM- |
| al | so, store the primitive values into $\tilde{R3972} \sim \tilde{R3975}$. | Ym: Y | 24 | |
| • W | hen there is line broken of the sensor, the value of line broken will be displayed. | AR: K TR: R | 3845 4 | |
| | | WR: R | 220 | |
| | | L | | |

| тятс | Convenient instruction of PID temperature control for FB-2AJ(K | ()4/FB-2AH(T)4 | FUN 73 TSTC |
|---|--|--|--|
| ×V re | Vhen total control points(Zh) of the FUN73 are greater than 4, it mu egisters storing the current values (starting from TR) must be contine | ust be Sh≧Sm a ous. | and the |
| M3 | | 73.TSTC | |
| | | -EN-1p:0 P1:0 | -ERR- |
| ۶ ــــــــــــــــــــــــــــــــــــ | | -H/C - Sm : 0 Ym : Y16 | -AO0 |
| When M3= thermocoup and store t | =ON, to measure the temperature of 1 st (Sm=0) \sim 4 th point of K-type ple inputs and store the engineering values of measurement into R0 \sim R3 he original values into R3968 \sim R3971. | AR: R3842 TR: R0 Yh: Y48 | -AO1 |
| When com control of 1 | pleting the measurement of $1^{st} \sim 16^{th}$ point, it will perform the PID heating 6 (Zh) points from 1^{st} (Sh=0) point to the 16^{th} point. | $\begin{array}{c} Sh &: 0\\ Zh &: 16\\ Sv &: R \\ \end{array}$ | 100 |
| • R0~R15: | Registers of current engineering value . | Os:R 1 | 120 |
| ● Y48~Y63 | : PID ON/OFF (PWM) output; it must be the transistor output. | PR:R I | 140 |
| ● R100~R11 | 15 : Registers of set point. | DR: R OR: R WR: R | 180 300 200 |
| ● R120~R13 | 35 : Registers of deviation zone, it determines whether temperature falls in set E.g. Set point is 200 and deviation zone is 5, then 195≤ Current value ≤ 205 means the temperature is in zone. | etting range. | |
| • R140~R1 | 55 : Setting point of gain (Kc). | | |
| • R160~R17 | 75 : Setting point of integral tuning constant (Ti) | | |
| • R180~R19 | 95 : Setting point of derivative tuning constant (Td). | | |
| • R300~R3 ² | 15 : Output of PID calculation (value from 0~4095). | | |
| • R200~R2' | 16 : Working registers. | | |
| l | | | |
| M3 | • | 43.NBMV | 200 |
| M3 M3 When M3= correspond | =ON, M1000 \sim M1015 tells the line broken status of ing sensor. | -EN- S:R2 Ns: D:WM10 Nd: | 200 0 000 0 |
| M3 When M3= correspond | =ON, M1000 \sim M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ | 200 0 000 0 |
| M3 When M3= correspond | ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \\ \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \end{bmatrix}$ | 200 0 000 0 220 0 000 |
| M3 When M3= correspond | =ON, M1000 \sim M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \\ \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \\ \end{bmatrix}$ $- 43.NBMV = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \\ \end{bmatrix}$ | 200 0 000 0 220 0 000 1 |
| M3 When M3= correspond | CON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ S & : R & 2 \end{bmatrix}$ | 200 0 000 0 220 0 000 1 230 |
| M3 When M3= correspond | =ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - S & 30.000 \\ S & 30.000 \\ Ns & 20.000 $ | 200 0 000 0 220 0 000 1 230 0 |
| M3 When M3= correspond | =ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Ns & : \end{bmatrix}$ | 200 0 000 0 220 0 000 1 230 0 000 2 |
| M3 When M3= correspond | =ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ | 200 0 000 0 220 0 0000 1 230 0 000 2 |
| M3 • When M3= correspond | [■] ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \end{bmatrix}$ | 200 0 000 0 220 0 000 1 |
| M3 • When M3= correspond | =ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ Ns & : \\ Ns & : \end{bmatrix}$ | 200 0 000 0 220 0 000 1 230 0 000 2 240 0 |
| M3 • When M3= correspond | =ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ Nd & : \\ D & : WM10 \\ Nd & : \\ \end{bmatrix}$ | $ \begin{array}{c} 200 \\ 0 \\ 000 \\ 0 \end{array} $ $ \begin{array}{c} 220 \\ 0 \\ 000 \\ 1 \end{array} $ $ \begin{array}{c} 230 \\ 0 \\ 000 \\ 2 \end{array} $ $ \begin{array}{c} 240 \\ 0 \\ 000 \\ 3 \end{array} $ |
| M3 • When M3= correspond | €ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : & D & : WM10 \\ Nd & : & \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : & D & : WM10 \\ Nd & : & \\ D & : WM10 \\ Nd & : & \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : & D & : WM10 \\ Nd & : & \\ D & : WM10 \\ Nd & : & \\ D & : WM10 \\ Nd & : & \\ 08 MOV - \\ \end{bmatrix}$ | 200 0 000 0 220 0 0000 1 230 0 000 2 240 0 0000 3 |
| M3 • When M3= correspond | ON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 5 & : R & 2 \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ | $ \begin{array}{c} 200 \\ 0 \\ 000 \\ 0 \end{array} $ $ \begin{array}{c} 220 \\ 0 \\ 000 \\ 1 \end{array} $ $ \begin{array}{c} 230 \\ 0 \\ 000 \\ 2 \end{array} $ $ \begin{array}{c} 240 \\ 0 \\ 000 \\ 3 \end{array} $ $ \begin{array}{c} 210 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ $ |
| M3 • When M3= correspond M3 • When M3= | CN, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 43.NBMV - S & : R & 2 \\ Ns & : D & : WM10 \\ Nd & : \\ 0 & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 08.MOV - S & : R & 2 \\ D & : WM10 \\ Nd & : \\ 0 & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 08.MOV - S & : R & 2 \\ D & : WM10 \\ Nd & : \\ -EN = \begin{bmatrix} 08.MOV - S & : R & 2 \\ D & : WM10 \\ S & : R & 2 \\ D & : WM10 \\ -EN = \begin{bmatrix} 08.MOV - S & : R & 2 \\ D & : WM10 \\ -EN \end{bmatrix}$ | $ \begin{array}{c} 200 \\ 0 \\ 000 \\ 0 \end{array} $ $ \begin{array}{c} 220 \\ 0 \\ 000 \\ 1 \end{array} $ $ \begin{array}{c} 230 \\ 0 \\ 000 \\ 2 \end{array} $ $ \begin{array}{c} 240 \\ 0 \\ 000 \\ 3 \end{array} $ $ \begin{array}{c} 210 \\ 016 \end{array} $ |
| M3 • When M3= correspond M3 • When M3= temperature | CON, M1000 ~ M1015 tells the line broken status of ing sensor. | $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 08.MOV - \\ S & : R & 2 \\ D & : WM10 \\ Nd & : \end{bmatrix}$ | $ \begin{array}{c} 200 \\ 0 \\ 000 \\ 0 \end{array} $ $ \begin{array}{c} 220 \\ 0 \\ 000 \\ 1 \end{array} $ $ \begin{array}{c} 230 \\ 0 \\ 000 \\ 2 \end{array} $ $ \begin{array}{c} 240 \\ 0 \\ 000 \\ 3 \end{array} $ $ \begin{array}{c} 210 \\ 016 \end{array} $ |
| M3 • When M3= correspond M3 • When M3= temperatur • M1032~M | FON, M1000 ~ M1015 tells the line broken status of ing sensor. FON, M1016 ~ M1031 tells the warning status of highest e warning or the heating circuit opened. 1047 tells the status of temperature in zone. | $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 43.NBMV - \\ S & : R & 2 \\ Ns & : \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 68.MOV - \\ S & : R & 2 \\ D & : WM10 \\ Nd & : \end{bmatrix}$ $-EN - \begin{bmatrix} 08.MOV - \\ S & : R & 2 \\ D & : WM10 \\ Nd & : \end{bmatrix}$ | $ \begin{array}{c} 200 \\ 0 \\ 000 \\ 0 \end{array} $ $ \begin{array}{c} 220 \\ 0 \\ 000 \\ 1 \end{array} $ $ \begin{array}{c} 230 \\ 0 \\ 000 \\ 2 \end{array} $ $ \begin{array}{c} 240 \\ 0 \\ 000 \\ 3 \end{array} $ $ \begin{array}{c} 210 \\ 016 \end{array} $ |

| FUN 73 TSTC | Convenient instruction of PID temperature control for FB-2AJ(K |)4/FB-2AH | H(T)4 | FUN 73 TSTC |
|--|--|---|-------------------------------------|--|
| Program | The main unit is FBx-40MC(A) ,and 4 temperature modu. The settings of input span are all at 5V (the polarity are fixed) | iles of FB-2 ed at bipola | 2AH4 ar). | are attached. |
| *** It tak modu *** Wher syste may | es only one FUN73 instruction to perform 16 points of PID temperature iles are identical in sensor type and the settings of input span and polarity performing the FUN73 instruction of the first time, the system will autom m default of gain (Kc), integral tuning constant (Ti), and derivative tuning change the settings if necessary. | control wh are the sar atically ass constant (| nen th me. sign to (Td), e | e temperature each point its etc. The user |
| | ſ | - 08D.MOV- | | |
| | EN- | S : WM 8 D : R 40 | 300 010 | |
| ● Ir ir pe (It | In status of M800 \sim M831 are controlled by the MMI or external puts to tell the status of sensor's installation; if it has the sensor, frorm line broken detection, and not to perform the check if it hasn't. needs the retentive function, so M800 \sim M1399 are the better choice). | | | l |
| ● W the | hen temperature sensor installed (the corresponding bit of R4010 or R4011 is 1) at esensor, the line broken value of that point will be displayed. | nd there is li | ne brol | ken of |
| ● W the | hen temperature sensor is not installed (the corresponding bit of R4010 or R4011 is line broken detection; the temperature of that point is displayed 0. | 0), there wil | l not pe | erform |
| | | - 08D.MOV- | | |
| • | | $S : WM \otimes P$ | 332 | |
| The second second | The status of M832 \sim M863 are controlled by the MMI or external inputs to tell ether it needs the PID control of the corresponding point; perform the PID eration when the bit is ON, and not to perform if it is OFF (It needs the entive function, so M800 \sim M1399 are the better choice). | D . K 40 | 112 | |
| ● W op | hen temperature control bit is ON (the corresponding bit of R4012 or R4013 is 1), eration of that point to obtain a suitable output signal. | FUN73 perfo | orms th | e PID |
| • W | hen temperature control bit is OFF (the corresponding bit of R4012 or R4013 is 0) PID operation of that point and output will be OFF. | , FUN73 will | l not pe | erform |
| M3 | | - 72.TP4 | | 1 |
| | EN- | Тр: P1 · | 2 | -ERR— |
| • w | hen M3=ON, to measure the temperature of 13 th (Sm=12) \sim 16 th point of | Sm : | 12 | -ALM — |
| P1 ~ | -100 RTD inputs and store the engineering values of measurement into R12 R15: also, store the primitive values into R3980~R3983. | Ym: Y AR: R 38 | 40 851 | |
| • W dis | hen there is line broken of the sensor, the value of line broken will be played. | TR : R WR: R | 12 240 | |
| M3 | | - 72.TP4 —— | 2 | |
| | EN- | Pl : | 3 | -ERR— |
| • w | hen M3=ON, to measure the temperature of 9 th (Sm=8) \sim 12 th point of PT-100 | Sm : | 8 | -ALM — |
| R | D inputs and store the engineering values of measurement into R8 \sim R11; also, | Ym: Y AR: R 38 | 32 848 | |
| ● W dis | hen there is line broken of the sensor, the value of line broken will be played. | TR : R WR: R | 8 230 | |
| M3 | | - 72.TP4 — | 2 | |
| | EN- | Pl: | 3 | -ERR— |
| • w | hen M3=ON, to measure the temperature of 5 th (Sm=4) \sim 8 th point of PT-100 | Sm : | 4 | -ALM — |
| R | D inputs and store the engineering values of measurement into $R4 \sim R7$; also, | Ym: Y | 24 845 | |
| ste | pre the primitive values into R3972~R3975. | TR: R | 4 | |
| • W dis | hen there is line broken of the sensor, the value of line broken will be played. | WR: R | 220 | |
| | | | | |

| FUN 73 TSTC | FUN 73 TSTC Convenient instruction of PID temperature control for FB-2AJ(K)4/FB-2AH(T)4 | | | | | | |
|--|--|---|-----------|--|--|--|--|
| | *When total control points(Zh) of the FUN73 are greater than 4 registers storing the current values (starting from TR) must be | i, it must be Sh≧Sn continous. | n and the | | | | |
| M3 | | $- \frac{73.TSTC}{Tn \cdot 2}$ | -FRR- | | | | |
| | | $-H/C - Sm^{-1} 0$ | -400- | | | | |
| | | Ym: Y16 | A01_ | | | | |
| When I RTD in store th | M3=ON, to measure the temperature of 1 st (Sm=0) \sim 4 th point of PT-100 puts and store the engineering values of measurement into R0 \sim R3 and e original values into R3968 \sim R3971. | AR: R3642 TR: R0 Yh: Y48 Sh: 0 | | | | | |
| When heating | completing the measurement of $1^{st} \sim 16^{th}$ point, it will perform the PID control of 16 (Zh) points from 1^{st} (Sh=0) point to the 16^{th} point. | $ \begin{array}{c} \text{Zh} : 16 \\ \text{Sv} : R \\ \text{Os} : R \\ 120 \end{array} $ |) | | | | |
| ● R0~R ² | 15 : Registers of current engineering value . | PR: R 140 |) | | | | |
| ● Y48~Y | '63 : PID ON/OFF (PWM) output; it must be the transistor output. | $\begin{array}{c} \mathbf{R} \\ \mathbf{DR} \\ \mathbf{R} \\ \mathbf{R} \\ \mathbf{R} \\ \mathbf{R} \\ 300 \end{array}$ | | | | | |
| ● R100~ | R115 : Registers of set point. | WR: R 200 | 5 | | | | |
| • R120~ | R135 : Registers of deviation zone, it determines whether temperature falls E.g. Set point is 200 and deviation zone is 5, then 195≤ Current value ≤ 205 means the temperature is in zo | in setting range. | | | | | |
| • R140~ | R155 : Setting point of gain (Kc). | | | | | | |
| • R160~ | R175 : Setting point of integral tuning constant (Ti) | | | | | | |
| • R180~ | R195 : Setting point of derivative tuning constant (Td). | | | | | | |
| • R300~ | R315 : Output of PID calculation (value from 0~4095). | | | | | | |
| • R200~ | R216 : Working registers. | | | | | | |
| | | | | | | | |
| Ma | | - 43.NBMV | | | | | |
| | • | -EN S : R 200 |) | | | | |
| When | M3=ON, M1000 \sim M1015 tells the line broken status of | Ns: $UD WM1000$ | | | | | |
| corresp | onding sensor. | Nd : 0 | | | | | |
| | | 43.NBMV- | | | | | |
| | | $-EN = \begin{bmatrix} S & : R & 220 \\ Na & & \end{bmatrix}$ | | | | | |
| | | D : WM1000 | | | | | |
| | | Nd : 1 | | | | | |
| | | $\begin{bmatrix} 43.\text{NBMV} \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 226 \\ 226 \end{bmatrix}$ | | | | | |
| | • | -EN S K 230 |) | | | | |
| | | D : WM1000 | | | | | |
| | | Nd : 2 | | | | | |
| | | $=$ $\begin{bmatrix} 43.\text{NBMV} \\ \text{S} \\ \text{S} \\ \text{S} \end{bmatrix} = \begin{bmatrix} 240 \\ 240 \end{bmatrix}$ | | | | | |
| | | -EN S K 240 Ns : (|) | | | | |
| | | D : WM1000 | 1 | | | | |
| | | Nd : 3 | | | | | |
| M3 | | $\begin{bmatrix} 08.MOV \\ S \rightarrow P & 210 \end{bmatrix}$ | | | | | |
| | • | -EN - B - K - 210 D : WM1016 | | | | | |
| When bigbost | M3=ON, M1016 \sim M1031 tells the warning status of | 08.MOV | | | | | |
| ■ M1032 | \sim M1047 tells the status of temperature in zone | -EN = S = R = 208 | 3 | | | | |
| | | D : WM1032 | | | | | |

Measuring instruction proper to FB-4AJ(K)xx temperature module



| FUN 85 TPSNS | Convenient instruction proper to FB-4AJ(K)xx temperature module | FUN 85 TPSNS | | | | | |
|--|---|---|--|--|--|--|--|
| User guide | User guide for convenient instruction FUN85 | | | | | | |
| When end store th ~ 2047 the ten temperate When th "ERR" was stored to be a stored to b | When execution control "EN"=1, this instruction will perform multiplexing temperature measurement and store the primitive value into R3968 (TP0) …R3991 (TP23); the value falls in 0~4095 (unipolar) or -2048 ~2047 (bipolar). And then base on the setting of temperature sensor (Tp), input span and polarity (PI) of the temperature module to scale the primitive values to engineering values and store them into temperature measurement registers (SR+0 as the 1st point,, SR+23 as the 24th point) When the setting of Tp · PI · Zn comes error, this instruction will not be performed and the output indication "ERR" will be ON. | | | | | | |
| When the second s | The sensor is K-type thermocouple (it needs FB-4AKxx module): the setting of input span and polarity is $0 \sim 10V$, the range of measurement will be $0 \sim$ then the display value is greater than 900°C, it means the line broken of the thermocour put indication "ALM" will be ON. the setting of input span and polarity is $0 \sim 5V$, the range of measurement will be $0 \sim 4$ then the display value is greater than 450°C, it means the line broken of the thermocour put indication "ALM" will be ON. the setting of input span and polarity is $-10 \sim 10V$, the range of measurement will be -2 then the display value is greater than 900°C, it means the line broken of the thermocour put indication "ALM" will be ON. the setting of input span and polarity is $-10 \sim 10V$, the range of measurement will be -200 then the display value is greater than $450°C$, it means the line broken of the thermocour put indication "ALM" will be ON. | 900°C. ple and the 50° C. ple and the $200 \sim 900^{\circ}$ C. ple and the $0 \sim 450^{\circ}$ C. ple and the | | | | | |
| When the second s | the sensor is J-type thermocouple (it needs FB-4AJxx module): the setting of input span and polarity is $0 \sim 10V$, the range of measurement will be $0 \sim 7$ ten the display value is greater than 900°C, it means the line broken of the thermoco- but indication "ALM" will be ON. the setting of input span and polarity is $0 \sim 5V$, the range of measurement will be $0 \sim 42$ ten the display value is greater than 450°C, it means the line broken of the thermoco- but indication "ALM" will be ON. the setting of input span and polarity is $-10 \sim 10V$, the range of measurement will be -42 the display value is greater than $900°C$, it means the line broken of the thermoco- but indication "ALM" will be ON. the setting of input span and polarity is $-10 \sim 10V$, the range of measurement will be $-100°C$, the setting of input span and polarity is $-5 \sim 5V$, the range of measurement will be $-100°C$, the setting of input span and polarity is $-5 \sim 5V$, the range of measurement will be $-100°C$, the setting of input span and polarity is $-5 \sim 5V$, the range of measurement will be $-100°C$, the setting of input span and polarity is $-5 \sim 5V$, the range of measurement will be $-100°C$, the setting of input span and polarity is $-10°C$, it means the line broken of the thermoco- ten the displayed temperature value is greater than $450°C$, it means the line broken of input span and polarity is $-5 \sim 5V$, the range of measurement will be $-10°C$, $-10°C$, it means the line broken of the line broken of the line broken of the line broken of input span and polarity is $-5 \sim 5V$, the range of measurement will be $-10°C$, | 750° C. Souple and the 20^C. Souple and the -200~750^C. Souple and the -200~420^C. roken of the | | | | | |
| SR : Sta SI WR : Sta The Bit B Carrowski | arting register of the engineering value of temperature measurement; it needs Zn register R+0 stores the 1 st point of temperature value, SR+1 stores the 2 nd point of temperature tarting of working register for this instruction. It takes 5 registers and can't be repeated to content of register WR+0 and WR+1 indicates the status of the sensor which is line to definition of WR+0 explained as follows: attribute to the temperature tarting that the 1 st point of sensor is line broken; attribute to form the temperature tarting that the 16 th point of sensor is line broken. attribute the temperature tarting that the 17 th point of sensor is line broken; attribute the temperature tarting that the 17 th point of sensor is line broken; attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. attribute the temperature tarting that the 24 th point of sensor is line broken. | sters in total. e value d in using. broken or not. | | | | | |
| FUN85 No mat "EN"=0 | can only be used once. ter the FUN85 is placed in main program or in sub-program, and whether the exe or 1, this instruction must be executed every scan. | ecution control | | | | | |

| FUN | 85 |
|-----|----|
| TPS | NS |

Convenient instruction proper to FB-4AJ(K)xx temperature module

FUN 85 TPSNS

Specific registers for FUN85

- R3968~R3991: Registers storing the primitive temperature value. R3968 storing the 1st point, R3969 storing the2nd point, etc. and R3991 storing the 24th point. The value is from 0~4095 (unipolar) or -2048~2047 (bipolar).
- R4000 : Low Byte of R4000 is generated from the system; FUN85 instruction will base on the setting of "temperature sensor (TP)" and "input span and polarity (PI)" to create the default and write it into the low byte of R4000. It is used to determine whether R4000~R4004 needs to be initialized; It is not allowed to change the low byte of R4000 by the user.
 - : High Byte of R4000 to tell the times for the average of measurement, which can be set by the user.
 - =0, no average; every acquired value is the measured value (default)
 - =1, average of 2 times; the average on the acquired 2 times of values is the measured value.
 - =2, average of 4 times; the average on the acquired 4 times of values is the measured value.
 - =3, average of 8 times; the average on the acquired 8 times of values is the measured value.
 - =4, average of 16 times; the average on the acquired 16 times of values is the measured value.
- R4001 : The factor for linear scaling to calculate the engineering value of K-type thermocouple while in positive temperature;
 - when the setting of input span and polarity for K-type thermocouple is $0 \sim 10V$ or $-10 \sim 10V$, the default value is 248.
 - when the setting of input span and polarity for K-type thermocouple is $0 \sim 5V$ or $-5 \sim 5V$, the default value is 124.
 - when the setting of input span and polarity for J-type thermocouple is $0 \sim 10V$ or $-10 \sim 10V$, the default value is 240.
 - when the setting of input span and polarity for J-type thermocouple is $0 \sim 5V$ or $-5 \sim 5V$, the default value is 120.
 - The expression for engineering value is as follows:
 - Engineering value = (Primitive temperature value ×R4001) /1024 (Unipolar).
 - Engineering value = (Primitive temperature value ×2×R4001) /1024 (Bipolar).

When there is a slight difference in measurement result between the standard meter and the FB-PLC's temperature module, if the user would like to use the value acquired by standard meter for correction, the user can tune the value of R4001 to get a better result in temperature measurement. This register provides fine tuning for positive temperature.

- R4002 : The factor for linear scaling to calculate the engineering value of K-type thermocouple while in negative temperature;
 - when the setting of input span and polarity for K-type thermocouple is $-10 \sim 10$ V or $-5 \sim 5$ V, the default value is 286.
 - when the setting of input span and polarity for J-type thermocouple is $-10 \sim 10V$ or $-5 \sim 5V$, the default value is 280.

The expression for engineering value is as follows:

- Engineering value = (Primitive temperature value \times R4002) /1024 ($-5 \sim 5$ V).
- Engineering value = (Primitive temperature value $\times 2 \times R4002$) /1024 (-10 \sim 10V).

When there is a slight difference in measurement result between the standard meter and the FB-PLC's temperature module, if the user would like to use the value acquired by standard meter for correction, the user can tune the value of R4002 to get a better result in temperature measurement. This register provides fine tuning for negative temperature.

- R4003 : The setting value for line broken detection of thermocouple;
 - when the setting of input span and polarity is $0 \sim 10V$ or $-10 \sim 10V$, the default value is 901. when the setting of input span and polarity is $0 \sim 5V$ or $-5 \sim 5V$, the default value is 451.

| [| | | I | | | | |
|---|---|--|---|--|--|--|--|
| FUN 85 TPSNS | Convenient instruction proper to FB-4AJ(K) | xx temperature module | FUN 85 TPSNS | | | | |
| • R4004 • R4010 | :Time interval between the measurement points wh The unit is in mS and the default value is 333, it m temperature. This means the update rate of the ten When the value of R4004 is 166, it means it needs 166mS to measure one point of The update rate of the temperature is 1 second (When the value of R4014 is 666, it means it needs 666mS to measure one point of The update rate of the temperature is 4 seconds When the value of R4014 is 1333, it means it needs 1333mS to measure one point The update rate of the temperature is 8 seconds : Each bit of R4010 to tell the status of the sensor's in Bit0=1 means that 1st point of temperature sensor | ile multiplexing. Which the us eans it needs 333mS to measu nperature is 2 seconds (333mS) of temperature. (166mS×6=996mS) of temperature. (666mS×6=3996mS) t of temperature. s (1333mS×4=7998mS) stallation. s installed. | ser can set up. ire one point of (6=1998mS) | | | | |
| ● R4011 | (The default of R4010 is FFFFH) : Each bit of R4011 to tell the status of the sensor's ins Bit0=1 means that 17th point of temperature sensor | stallation. is installed. | | | | | |
| | Bit7=1 means that 24 th point of temperature sensor (The default of R4011 is FFFFH) | is installed. | | | | | |
| When will per will hav When system temper Depen R4011 | When the temperature sensor is installed (the corresponding bit of R4010 or R4011 must be 1), the system will perform the line broken detection to the sensor. If there is line broken happened to the sensor, there will have the warning and the line broken value will be displayed. When the temperature sensor is not installed (the corresponding bit of R4010 or R4011 must be 0), the system won't perform the line broken detection to the sensor and there will not have the warning; the temperature value will be displayed as 0. Depends on the sensor's installation, the ladder program may control the corresponding bit of R4010 and R4011 to tell FUN85 to perform or not to perform the line broken detection. | | | | | | |
| Program ex | Example In following examples, the main unit is F module is attached ; the setting of the input ample 1 | Bx-28MC(A), and the FB-4AK2 span and polarity is $0 \sim 10$ V. | 4 temperature | | | | |
| M0 When (Zn=2 engin the pr When ON at | EN- M0=ON, to measure the temperature of $1^{st} \sim 24^{th}$ 4) point of K-type thermocouple inputs and store the eering values of measurement into R0~R23; also, store imitive values into R3968~R3991. there is line broken in K-type thermocouple, M1 will be hd the line broken value of this point will be displayed. | 85.TPSNS Tp: 0 Pl: 0 Zn: 24 Yn: Y SR: R WR: R | M1 () | | | | |
| M0 | EN- | 08D.MOV S : R 100 D : WM1000 | | | | | |
| corre | sponding sensor. | | | | | | |



| FUN 86 TPCTL | | FUN 86 TPCTL | | | | | |
|---|-------------------------------------|---|---|-------------------|---|---|--|
| TPCTL Execution contr Heating/Coolin Rar Ope- rand Yn Sn Zn Sv Os PR IR DR OR OR | rol—EN ng—H/C Y0 Y255 O | 86.T Yn : Zn : Sv : Os : PR : IR : DR : OR : WR : HR R3839 | PCTL- ROR R5000 R8071 * * * * * * * * * | DR D0 D3071 | FE -ERR- -ALM- -ALM- 0~23 1~24 | B-4AJ(K)xx module —Parameter error —Warning indication Yn: Starting address of PID ON/O it takes Zn points. Sn: Starting point of PID control of Sn = 0~23. Zn: Number of the PID control of t 1≤Zn≤24 and 1≤Sn+Zn≤24 Sv: Starting register of the setpoin it takes Zn registers. Os: Starting register of the in-zone it takes Zn registers. PR: Starting register of the gain (H it takes Zn registers. IR: Starting register of integral tun (Ti); it takes Zn registers. DR: Starting register of the PID ar it takes Zn registers. OR: Starting register of the PID ar it takes Zn registers. WR: Starting of working register for instruction. It takes 9 registers and can't | TPCTL FF output; f this instruction; this instruction; this instruction; tt; e offset; (c); ing constant tuning constant tuning constant nalog output; or this be repeated in |
| Note: FUN86 | must inc | orpora | 10^{-1} | ו FUN | 85 wher | n using. | |
| Function guide and notifications Fun85 instruction employs the multiplexing temperature module FB-4AJ(K)xx (where, xx may be 12,16,24) to get the current value of temperature and let it be as so called Process Variable (PV); after the calculation | | | | | | | |

- of software PID expression, it will respond the error with an output signal according to the setting of Set Point (SP),the error's integral and the rate of change of the process variable. Through the closed loop operation, the steady state of the process may be expected.
 Convert the output of PID calculation to be the time proportional on/off (PWM) output, and via transistor
- Convert the output of PID calculation to be the time proportional on/off (PWM) output, and via transistor output to control the SSR for heating or cooling process; this is a good performance and very low cost solution.
- Through the analog output module (D/A module), the output of PID calculation may control the SCR or proportional valve to get more precise process control.
- Digitized PID expression is as follows:

$$Mn = [Kc \times En] + \sum_{0}^{11} [Kc \times Ti \times Ts \times En] - [Kc \times Td \times (PVn - PVn - 1)/Ts]$$

Where,

Mn: Output at time "n". Kc: Gain (Range: 1~999 ; Pb=100(%) / Kc) Ti: Integral tuning constant (Range:0~999, equivalent to 0.00~9.99 Repeat/Minute) Td: Derivative tuning constant (Range:0~999, equivalent to 0.00~9.99 Minute) PVn: Process variable at time "n" PV n-1: Process variable when loop was last sovled En: Error at time "n" ; E= SP – PVn Ts: Solution interval for PID calculation (Valid value are 10, 20, 40, 80 ;the unit is in 0.1Sec)

| FUN 86 | Convenient instruction of PID temperature control proper to FB-4AJ(K)xx | FUN 86 |
|--------|---|--------|
| TPCTL | module | TPCTL |

Principle of PID parameter adjustment

- As the gain (Kc) adjustment getting larger, the larger the proportional contribution to the output. This can obtain a sensitive and rapid control reaction. However, when the gain is too large, it may cause oscillation. Do the best to adjust "Kc" larger (but not to the extent of making oscillation), which could increase the process reaction and reduce the steady state error.
- Integral item may be used to eliminate the steady state error. The larger the number (Ti, integral tuning constant), the larger the integral contribution to the output. When there is steady state error, adjust the "Ti" larger to decrease the error.

When the "Ti" = 0, the integral item makes no contribution to the output.

For exa., if the reset time is 6 minutes, Ti=100/6=17 ; if the integral time is 5 minutes, Ti=100/5=20.

- Derivative item may be used to make the process smoother and not too over shoot. The larger the number (Td, derivative tuning constant), the larger the derivative contribution to the output. When there is too over shoot, adjust the "Td" larger to decrease the amount of over shoot. When the "Td" = 0, the derivative item makes no contribution to the output.
 For exa, if the rate time is 1 minute, then the Td = 100; if the differential time is 2 minute, then the Td = 200.
- Properly adjust the PID parameters can obtain an excellent result for temperature control.
- The default of gain value (Kc) is as follows:

When the setting of span and polarity of the module is $0 \sim 10V$, the default of gain (Kc) is 60. When the setting of span and polarity of the module is $0 \sim 5V$, the default of gain (Kc) is 30. When the setting of span and polarity of the module is $-10 \sim 10V$, the default of gain (Kc) is 120.

When the setting of span and polarity of the module is $-5 \sim 5V$, the default of gain (Kc) is 60.

- The default of integral tuning constant is 17, it means the reset time is 6 minutes (Ti=100/6=17).
- The default of derivative tuning constant is 100, it means the rate time is 1 minutes (Td=100).

Instruction guide

- FUN86 instruction must be incorporated with FUN85; the FUN85 instruction is for temperature measurement and it must be enabled, then, can the FUN86 start working.
- When execution control "EN" = 1, it depends on the input status of H/C for PID operation to make heating (H/C=1) or cooling (H/C=0) control. The current values of measured temperature are through the multiplexing temperature module FB-4AJ(K)xx to get; the set points of desired temperature are stored in the registers starting from Sv. With the calculation of software PID expression, it will respond the error with an output signal according to the setting of set point, the error's integral and the rate of change of the process variable. Convert the output of PID calculation to be the time proportional on/off (PWM) output, and via transistor output to control the SSR for heating or cooling process; where there is a good performance and very low cost solution. It may also apply the output of PID calculation (stored in registers starting from OR), by way of D/A analog output module, to control SCR or proportional valve, so as to get more precise process control.
- When the setting of Sn, Zn ($0 \le Sn \le 23$ and $1 \le Zn \le 24$, as well as $1 \le Sn + Zn \le 24$) comes error, this instruction will not be executed and the instruction output "ERR" will be ON.
- This instruction compares the current value with the set point to check whether the current temperature falls within deviation range (stored in register starting from Os). If it falls in the deviation range, it will set the in-zone bit of that point to be ON; if not, clear the in-zone bit of that point to be OFF, and make instruction output "ALM" to be ON.

| | FUN 86Convenient instruction of PID temperature control proper toTPCTLFB-4AJ(K)xx module | | | | | | |
|--|--|---|-------------------------------------|--|--|--|--|
| In the mean time, this instruction will also check whether highest temperature warning (the regis point of highest temperature warning is R4008). When successively scanning for ten time values of measured temperature are all higher than or equal to the highest warning set point, t will set to be ON and instruction output "ALM" will be on. This can avoid the safety problem temperature out of control, in case the SSR or heating circuit becomes short. | | | | | | | |
| | This instruction can also detect the unable to heat problem resulting from the SSR or heating circu or the obsolete heating band. When output of temperature control turns to be large power (se register) successively in a certain time (set in R4007 register), and can not make current temper desired range, the warning bit will set to be ON and instruction output "ALM" will be ON. | | | | | | |
| | WR: St | arting of working register for this instruction. It takes 9 registers and can't be repeated ir | n using. | | | | |
| | T w in | he content of the two registers WR+0 and WR+1 indicating that whether the current tem ithin the deviation range (stored in registers starting from Os). If it falls in the deviation -zone bit of that point will be set ON; if not, the in-zone bit of that point will be cleared C | perature falls range,the PFF. | | | | |
| | Bi | t definition of WR+0 explained as follows: Bit0=1, it represents that the temperature of the Sn+0 point is in-zone… Bit15=1, it represents that the temperature of the Sn+15 point is in-zone. | | | | | |
| Bit definition of WR+1 explained as follows: Bit0=1, it represents that the temperature of the Sn+16 point is in-zone Bit7=1, it represents that the temperature of 24th point is in-zone. | | | | | | | |
| The content of the two registers WR+2 and WR+3 are the warning bit registers, they indiacte whether there exists the highest temperature warning or heating circuit opened. | | | | | | | |
| | Bit definition of WR+2 explained as follows: Bit0=1, it means that there exists the highest warning or heating circuit opened at the Sn+0 point Bit15=1, it means that there exists the highest warning or heating circuit opened at the Sn+15 point. | | | | | | |
| | Bi | t definition of WR+11 explained as follows: | | | | | |
| Bit0=1, it means that there exists the highest warning or heating circuit opened at the Sn+16 point Bit7=1, it means that there exists the highest warning or heating circuit opened at the 24th point. Registers of WR+4 \sim WR+8 are used by this instruction. | | | | | | | |
| | • This ins | struction can only be used to perform heating or cooling control of positive temperature. | | | | | |
| | Whether instruct | er the FUN86 is placed in main or sub program and no matter the execution control "E ion must be executed every scan. | N"=0 or 1, this | | | | |
| | Specific reg | gisters related to FUN86 | | | | | |
| | • R4005 : : | The content of Low Byte to define the solution interval between PID calculation =0, perform the PID calculation evey 2 seconds (System default). =1, perform the PID calculation evey 4 seconds. =2, perform the PID calculation evey 8 seconds. ≥3, perform the PID calculation evey 1 second. (R4004 must be 166 to make sense) The content of High Byte to define the cycle time of PID ON/OFF (PWM) output. =0 · PWM cycle time is 2 seconds (system default) =1 · PWM cycle time is 4 seconds. =2 · PWM cycle time is 8 seconds. ≥3 · PWM cycle time is 1 second. | | | | | |
| | Note 1: Wher when | n changing the value of R4005, the execution control "EN" of FUN86 must be set at 0. execution control "EN" =1, it will base on the latest set point to perform the PID calcula | The next time tion. | | | | |
| | Note 2: The s | maller the cycle time of PWM, the more even can it perform the heating. However, the PLC scan time will also become greater. For the best control, it can base on the sca | e error caused | | | | |

by the PLC scan time will also become greater. For the best control, it can base on the scan time of PLC to adjust the solution interval of PID calculation and the PWM cycle time.

| FUN 86 TPCTL | Convenient instruction of PID temperature control proper to FB-4AJ(K)xx module | FUN 86 TPCTL | | | | | |
|--|--|---------------------------------|--|--|--|--|--|
| • R4006: | R4006: The setting point of large power output detection for SSR or heating circuit opened, or heating band obsolete. The unit is in % and the setting range falls in 80~100(%); system default is 90(%). | | | | | | |
| • R4007: | R4007: The setting time to detect the continuing duration of large power output while SSR or heating circuit opened, or heating band obsolete. The unit is in second and the setting range falls in 300~65535 (seconds); system default is 600 (seconds). | | | | | | |
| • R4008: | The setting point of highest temperature warning for SSR, or heating circuit short det unit is in degree and the setting range falls in $50 \sim 65535$; system default is 350 (degree | ection. The es). | | | | | |
| ● R4012: | Each bit of R4012 to tell the need of PID temperature control. Bit0=1 means that 1 st point needs PID temperature control. Bit1=1 means that 2 nd point needs PID temperature control. | | | | | | |
| | Bit15=1 means that 16th point needs PID temperature control. (The default of R4012 is FFFFH) | | | | | | |
| • R4013: | Each bit of R4013 to tell the need of PID temperature control. Bit0=1 means that 17 th point needs PID temperature control. Bit1=1 means that 18 th point needs PID temperature control. | | | | | | |
| | Bit7=1 means that 24 th point needs PID temperature control. (The default of R4013 is FFFFH) | | | | | | |
| ● While e bit of R calcula | execution control "EN"=1 and the corresponding bit of PID control of that point is ON (co 24012 or R4013 must be 1), the FUN73 instruction will perform the PID operation and re tion with the output signal. | orresponding spond to the | | | | | |
| ● While e bit of R will be | execution control "EN"=1 and the corresponding bit of PID control of that point is OFF (co 24012 or R4013 must be 0), the FUN73 will not perform the PID operation and the output OFF. | orresponding t of that point | | | | | |
| The lac not to p | der program may control the corresponding bit of R4012 and R4013 to tell the FUN73 | to perform or | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |



| FUN 86 TPCTL | FUN 86 Convenient instruction of PID temperature control proper to TPCTL FB-4AJ(K)xx module | | | | | |
|--|---|-----------------|---|---|--------------------------------|--|
| M • W (Z • Y • R • R | 2 /hen M2=ON, it will perform the PID heating control of 20 Zn=20) points from the1 st (Sn=0) point to the 20 th point. 40~Y49: PID ON/OFF (PWM) output; it must be the transistor output. 100~R119: Registers of set point. 120~R139: Registers of deviation zone, it determines whether the temperature falls in setting range. E.g. Set point is 200 and deviation zone is 5, then 195≤ Current value ≤ 205 means the te | — EN- - H/C- | 86.TPCTL Yn:Y Sn: Zn:Z Sv:R PR:R IR:R PR:R IR:R OR:R QWR:R 22 ature is in zone. | 30 -ERR 0 20 -ALM 0 0 0 0 0 0 0 0 0 0 0 0 0 | M3 —() | |
| • R • R • R • R • W • W | 140~R159: Setting point of gain (Kc). 160~R179: Setting point of integral tuning constant (Ti). 180~R199: Setting point of derivative tuning constant (Td). 200~R219: Output of PID calculation (value from 0~4095). 220~R228: Working registers /hen one of the temperatures is not in zone, or there exipened, the status of M3 will be ON. | sts hi | ghest temperati | ure warning or t | neating circuit | |
| M • W pr te | 2 /hen M2=ON, the M1024 \sim M1043 tells the oint which temperature is in zone, and M1048 \sim M1067 tells the point which has highest emperature warning or heating circuit opened. | - EN | 08D.MOV S : R 22 D : WM102 08D.MOV S : R 22 D : WM104 | 0 4 2 8 | | |
| M | 4 | — EN- | 86.TPCTL Yn:Y 5 Sn: 2 | 58 -ERR | | |
| • W (2 • Y • R • R • R • R • R • R | /hen M4=ON, it will perform the PID cooling control of 3 Zn=3) points from the 21st (Sn=20) point to the 23rd point. 58~Y60: PID ON/OFF (PWM) output; it must be the transistor output. 300~R302: Registers of set point. 305~R307: Registers of deviation zone, it determines whether the temperature falls in setting range. E.g. Set point is 200 and deviation zone is 5, then 195≤ Current value ≤ 205 means the te 310~R312: Setting point of gain (Kc). 315~R317: Setting point of integral tuning constant (Ti) 320~R322: Setting point of derivative tuning constant (Td). 325~R327: Output of PID calculation (value from 0~4095). | H/C- | Zn : Sv : R 30 Os : R 30 PR : R 31 IR : R 31 DR : R 32 OR : R 32 WR: R 33 | 3 -ALM 00 5 1 5 | | |
| ● R Note: When pe gain (Kc | 330~R338:Working registers. erforming the instruction of the first time, the FUN86 will aut | omatio | cally assign to e , etc. They ma | each point its sys | stem default for necessary. | |



| FUN 86 TPCTL | Convenient instruction of PID temperature control proper to FB-4AJ(K)xx module | | | | FUN 86 TPCTL | |
|---|--|---------------------------|---|--|--|--|
| • The extension of the | status of M832 \sim M851 are controlled by the MMI or rnal inputs to tell whether it needs the PID control of the esponding point; perform the PID operation when the bit N, and not to perform if it is OFF (It needs the retentive tion, so M800 \sim M1399 are the better choice). | – EN - | 08D.MO S : WM D : R | V 4 832 4012 L | | |
| • Wi (Zr • Y3 • R1 • R1 | hen M2=ON, it will perform the PID heating control of 20 =20) points from the1st (Sn=0) point to the 20th point. 0~Y49: PID ON/OFF (PWM) output; it must be the transistor output. 00~R119: Registers of set point. 20~R139: Registers of deviation zone, it determines whether the temperature falls in setting range. | — ЕN- | Sn : Zn : Sv : R Os : R PR : R IR : R DR : R OR : R WR: R | 0 20 100 120 140 160 180 200 220 | -ERR— -ALM—— | M3 -() |
| R1 R1 R1 R2 R2 With Withop With | E.g. Set point is 200 and deviation zone is 5, then 195≤ Current value ≤ 205 means the ter 40~R159: Setting point of gain (Kc). 60~R179: Setting point of integral tuning constant (Ti). 80~R199: Setting point of derivative tuning constant (Td). 00~R219: Output of PID calculation (value from 0~4095). 20~R228: Working registers then one of the temperatures is not in zone, or there exists the status of M3 will be ON. then temperature control bit is ON (the corresponding bit deration of that point to obtain a suitable output signal. | highes of R4 f R401 | ature is in z st temperat 4012 or R4 2 or R4013 | zone. ture warn 4013 is 3 is 0), Fl | ing or heating 1), FUN86 per JN86 will not p | circuit opened, forms the PID erform the PID |
| Note: | When performing the instruction of the first time, the FUN default for gain (Kc), integral tuning constant (Ti), and changed if necessary. | V86 w deriv: | ill automat ative tunin | ically ass g consta | sign to each po nt (Td), etc. | bint its system They may be |
| M2 Wł po M1 hig op | then M2=ON, the M1024 \sim M1043 tells the int which temperature is in zone, and 048 \sim M1067 tells the point which has wheat temperature warning or heating circuit ened. | – EN - | 08D.MO S : R D : WN 08D.MO S : R D : WN | $v = \frac{220}{41024}$ $v = \frac{222}{41048}$ | | |